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ABSTRACT

This course entitled "Biology" is one of a series of instructional guides prepared by teachers for the Sahuarita High School (Arizona) Career Curriculum Project. It consists of 11 units of study, and 45 behavioral objectives relating to these units are listed. The topics covered include observation, measurement, scales and magnification, the microscope, characteristics of living things, observation and classifying, spatial relationships, constructing inferences and defining operationally, cells, plant reproduction, and heredity. The units provide a statement of the rationale, objectives, sources of information, a series of student activities, and answers to the activity problems. For related units in this series see SE 016 635 - SE 016 644. (JR)

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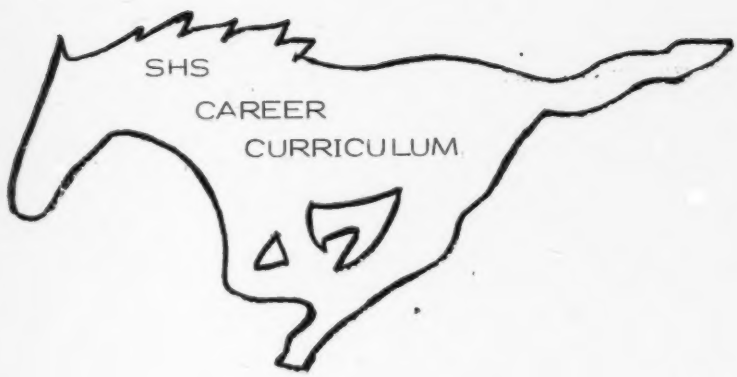
SAHUARITA HIGH SCHOOL

CAREER

CURRICULUM

PROJECT



COURSE TITLE: BIOLOGY

BY

ROBERT ESSER

SE 016 636

COURSE TITLE: BIOLOGY

OBJECTIVES

1. Construct a list of observable properties of an object, using at least four of your five senses.

2. Construct a ruler using arbitrary units and name the lengths of objects using these units.

3. Describe the changes caused by the manipulation of an object.

4. Construct a list of observable properties of an object which will allow another individual to distinguish between the object and other similar objects.

5. List four occupational areas in which observation and measurements is needed and relate these to occupational clusters and be able to tell your instructor what a vocation is.

6. Name lengths of objects to the nearest mm,using a metric ruler.

7. Identify abbreviations from common metric units of length and mass.

8. Order three or more objects by length or mass.

9. Apply rules to convert from one unit of metric length or mass to another.

10. Identify a career where measurement is important. Write a short report telling how and in what units measurement is used.

11. Apply a rule to determine the size of an object on the basis of a picture of the and the magnification of the picture.

12. Apply arule to determine the size of an object on the basis of a picture of the object and a scale for the picture.

13. Tell about one career of your choice using these areas as a guide limit:
    1. Where does one get the skills?
    2. How and where do you apply?
    3. What exactly would you do the job?

14. Demonstrate the technique for preparing an unstained or a stained wet mount.

15. Apply a rule to calibrate the field of vision of a microscope.

16. Demonstrate the measurement of microscopic objects with a microscope and a ruler.

17. List three skills and three separate careers in the field of Health and Marine Science which use the microscope.

18. Identify organic objects from inorganic objects.

19. Define the classification group Protista.

20. Culture one group of microorganism from three available and describe the growth and reproduction, over a two-week period.

21. List three careers in different areas that have to do with life, one of which must deal with microorganisms.

22. Be able to define the world of work in everything no more than one page 8 1/2" by 11".

23. Use the library in finding careers in career clusters.

24. Describe one of more members of a set of objects so that another individual will be able to identify or name the object or objects.

25. Construct a multistage classification for a set of objects.

26. Construct a dichotomous key which will enable another individual to name unknown members of a set of objects.

27. Describe the Kingdoms of Organism.

28. Describe Phylums of the Kingdoms as listed in the activities.

29. Name and order in the system of taxonomy two organisms from Kingdom to species.

30. Given an object and sectional views of the object, name whether the views are cross of longitudinal and identify the point on the object from which the section was taken.

31. Given a set of ordered serial-cross-sections construct a drawing of a longitudinal view of the object.

32. Demonstrate the serial sectioning of an object, construct drawings of the sections and order the drawings.

33. Using any resources, pick at least one career in which you are interested.

34. Distinguish between observations and inferences about objects.

35. Construct inferences based on observations of biological objects or phenomenon.

36. Distinguish between an operational and descriptive definition.

37. Construct an operational definition of an object which is being observed and/or manipulated.

38. List attitudes and work habits you would expect an employee to have in the career area of your choice.

39. Construct and name the parts of a cell.

40. Distinguish 5 different kinds of cells.

41. Describe the cell parts.

42. Describe careers in Vet medicine. At least 5 of them with the amount of training needed to obtain the jobs.

43. Demonstrate the ability to make a mount of an onion and use the microscope in finding cell parts.

44. Describe how cell reproduction occurs in cells with a recognizable nucleus. (mitosis)

45. Distinguish the results of mitosis on unicellular and multicellular organisms.

UNIT I - WHAT YOU SEE IS ___ ___ ___!

RATIONALE: _

The primary process one must master in order to learn to do science, is that of observation. On the basis of observations, the scientist is able to design experiments, collect data, and draw valid conclusions. You will, therefore, begin your study of biology, by learning how scientists observe.

In its simplest form, observation is based only upon your senses. If you could not see, hear, taste, smell or feel, you would have no contact at all with the world around you. Your senses can be expanded through the use of tools, such as the microscope, and so you will also have to learn to use such devises.

Finally, you have the ability to manipulate or cause changes in objects. By observing changes, much additional information can be gained.

OBJECTIVES:

The student should:

1. Construct a list of observable properties of an object, using at least four of your five senses.

2. Construct a ruler using arbitrary units and name the lengths of objects using these units.

3. Describe the changes caused by the manipulation of an object.

4. Construct a list of observable properties of an object which will allow another individual to distinguish between the object and other similar objects.

5. List four occupational areas in which observation and measurements is needed and relate these to occupational clusters and be able to tell your instructor what a vocation is.

SELF APPRAISAL

Obtain a packet of objects from the supply room. Using only your five senses, make observations of these objects. List your observations in Column 1 of the Observation Data Sheet found at the end of this section. Use a separate data sheet for each of the objects. Then manipulate each of the objects and record any additional observations. These observations should also be written in Column 1.

Finally, in the lower section of Column 1, list any differences which might enable an outside observer to distinguish the objects. Save Column 2 for observations you make later in the course.

Score your ability to observe, using the following scale:*

Sight Taste Smell Touch Sound	1 point each	Quantitative Observations	3 points each.	Observations based on Manipulations	2 points each

*Adapted from Science, A Process Approach, Xerox Corp.

For conclusions based on observations, rather than direct observation, 3 points will be deducted. Example: If you drop a few grains of salt on the table and say, "There wasn't any sound," you are forming a conclusion. You should say, "I didn't hear any sound," since the object probably does make a sound which is inaudible.

If you can get 25 points, you are an excellent observer; 20 points is fair; and 15 or below is very poor. On the evaluation you must get 25 or more points. Be sure that your descriptions are

based only on your observations. Do not draw conclusions. List only what you observe, not what you think.

INFORMATION SOURCES AND ACTIVITIES

1. There are various ways by which you can observe objects or procedures. The simplest of these is with your senses. Perhaps in the past, when you observed an object, you described only the color and shape. Now, however, you must learn to use all of your senses. Below is a list of observations you might make. Can you make the list longer?

1. With your sight you may be able to tell:

   a. color
   b. shape
   c. color tonal value
   d. texture
   e. how light is absorbed, transmitted, or reflected
   f. whether the object is transparent, translucent or opaque

2. With touch, you may be able to tell:

   a. texture
   b. temperature
   c. hardness
   d. weight (heavy or light)

3. By smelling, you may decide the object is:

   a. pungent
   b. aromatic
   c. smells just like another familiar object

4. The object may taste:

   a. bitter
   b. sweet
   c. sour
   d. bland
   e. salty
   f. hot or cold
   g. may taste just like another familiar object

5. If the object makes a sound you can describe:

   a. the pitch (frequency) of the sound (high or low)
   b. the volume (intensity) of the sound (number of decibels)
   c. the duration of the sound (how long it lasts)

If you observe an object using as many of the above items as possible, you have not only used all of your senses, but you have made two types of observations. Most of the observations were

qualitative. Qualitative observations do not involve numbers. When you say an object is red or blue, you have made a qualitative distinction. Quantitative observations involve measurements and include a number. When you say the duration of a sound is three seconds, you have made a quantitative observation. Now go back to the list and place a check (✓) in front of the observations which you think might be quantitative. We found 6 of these which can be measured quantitatively.

Another common practice in describing observations is that of comparing characteristics of the object being observed with other common objects. for example, when you say an object tastes salty, you are comparing the object with salt. When you say an object is as heavy as lead, you are comparing the weights of the two objects and making the assumption that this object is really as heavy as lead. This method is a good one, if properly applied, but you must be sure that your comparisons are valid. How do you measure how heavy an object is? Is that object really as smooth as glass? When you are observing scientifically, your descriptions must be accurate, or you may confuse the individual reading or listening to your description.

Now place an (*) in front of the items in the list which may best be described by comparison. We think that almost all of these may best be described by comparison.

There are many common ways to make comparisons, but in this section we will consider length.

2. If you can describe the weight and length of an object, one can generally distinguish it from many other objects. You can

determine length by constructing a ruler. Find the center of a 3x5 card by folding it in half and marking the folding point with a pencil. Then fold one side in half again and make another mark. Continue doing this until the smallest unit is 1/32 of the length of the card. Your "ruler" should then look like this.

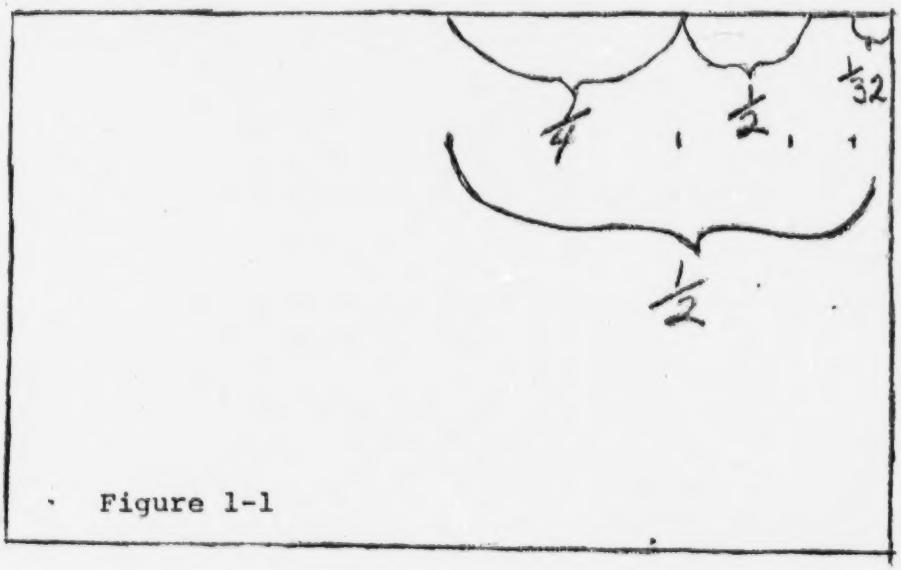


Figure 1-1

You can now describe objects more accurately because you can give quantitative measurements. The line below is 3/8 cards long. Figure 1-2

Notice, also, that in order for our measurement (3/8) to have meaning, we must give the units of measurement, in this case cards. Thus, we are comparing the length of a standard length with which you are familiar. If you don't know how long a "card" is, the quantitative observation will have no meaning.

Be sure that when you make a comparison, the person is familiar with the object to which you are referring. If the height of an object is the same as that of a zarf, you won't know what we are

talking about, since you not only are probably unfamiliar with zarfs, but they also come in different sizes.

3. Another common method of making observations involve doing something with the object which might cause it to change. When a seed is planted, various properties become apparent that wouldn't be noticeable otherwise.

Some ways that you might observe changes in objects are listed below. Of course, you wouldn't do all of these things with all objects. What changes, if any, take place when you:

a. drop them
b. plant them
c. submerse them in water
d. mold them
e. crush them
f. dissolve them
g. scratch them
h. heat them
i. cool them
j. dissect them

Can you think of any other manipulations you might add to the list? The way in which objects change when they are manipulated gives a scientist a great deal of information about them. If, for example, gas causes a glowing splint to burst into flame, that gas is oxygen.

4. The final skill involved in observation is that of distinguishing between similar objects from descriptions based on observations. In what ways are objects similar and in what ways are they different? Similarities can be used to group objects together, but differences must be used to tell them apart. Therefore, given a group of similar objects, you should be able to list enough differences so that others can tell them apart.

5. Get the filmstrip on An Introduction to Vocations if you missed the class presentation also listen to the Cosett tape on this subject while watching.

UNIT II

IS IT BIG, HEAVY, LONG, SHORT, OR A C.C.?

RATIONALE:

Being careful in measurement is important. This indicates reliability on your part. This measurement business is not only in distance; it is time, volume, and also how a student measures up to the task he is doing. This last part for sure is extremely important in being successful in a career of your choice. Also, how you get along with people, fellow employees, customers, friends and other people you come in contact with in day-to-day living is important.

Getting to work on time, doing a good job and taking pride in what you do well, will not only make you a success in a career but also in this class as well as the others.

OBJECTIVES:

The student should:

11. Name lengths of objects to the nearest mm, using a metric ruler.

12. Identify abbreviations from common metric units of length and mass.

13. Order three or more objects by length or mass.

14. Apply rules to convert from one unit of metric length or mass to another.

14a. Identify a career where measurement is important. Write a short report telling how and in what units measurement is used.

SELF LEARNING TEST

1A

There are only four metric units of most commonly used in biology. These are the gram, the kilogram, the milligram, and the microgram. The gram is the basic unit of mass, just as the meter is the basic unit of length in the metric system. The prefixes for the units of mass indicate the relationships of these units to the gram.

PLEASE TURN TO 2A

1B

You are correct. A microgram is 1/1,000,000 of a gram. This is a very small unit. Quantities this small cannot be measurered on a balance and must be prepared in other ways. If, for your work, you need to measure in these units, you will receive additional instruction.

PLEASE TURN TO 2B

From 2A

1C

Your answer was: A kilogram is equal to 1/1000 of a gram. Although this answer is not correct, you knew that the prefix kilo- was related to the gram by a factor of 100 meters; one kilogram is equal to 1000 grams. The prefix kilo0 means 1,000, rather than 1/1000. Please return to 2A and select the other answer.

PLEASE RETURN TO 2A

From 1A

2A

Choose the correct statement:

1. A kilogram is equal to 1000 grams.

PLEASE TURN TO 4A

2. A kilogram is equal to 1/1000 of a gram.

PLEASE TURN TO 1C

From 1B

2B

The final unit of mass with which you must be familiar is the milligram. The prefix milli- means 1/1000, so a milligram is 1/1000 of a gram.

PLEASE TURN TO 3B

2C

From 6B

You made the same mistake as many other people who are not familiar with the metric system.

The prefix micro means 1/1,000,000 of a unit. In this case the basic unit is a gram, so a microgram is one one-millionth of a gram. Please return to 6B and select the other answer.

PLEASE RETURN TO 6B

3A

From 4C

$$50\ \mu g \times \frac{1\ mg}{1000\ \mu g} = \underline{\qquad\qquad}$$

PLEASE TURN TO 5A

3B

From 2B

This table summarizes the units of mass you must know.

/Table 3-3/

1 kilogram (kg) = 1000 grams (g)
1 gram (g) = 1000 milligrams (mg)
1 gram (g) = 1,000,000 micrograms (μg)
1 milligram (mg) = 1000 micrograms (μg)

PLEASE TURN TO 4B

3C

From 8A

You have selected your answer without thinking far enough ahead. Let us continue with the problem as though you had chosen the correct answer. The next step in conversion is to multiply the conversion factor by the number given in the problem. The problem was 50 μg = ___ mg. Multiplying 50 μg x the conversion factor, we get $50\ \mu g \times \frac{1000\ \mu g}{1\ mg}$.

For the moment, ignore the numbers

PLEASE TURN TO 5C

4A

From 2A

You are correct; a kilogram is 1000 grams. The prefix kilo- means 1000; in this case 1000 grams.

PLEASE TURN TO 6B

From 3B

Now see if you can fill in the blanks without looking at the table.

4B

1. 1000 g = _____ kg
2. 1000 μg = _____ mg
3. 1000 mg = _____ g

PLEASE TURN TO 5B

From 5B

Good! You have chosen the correct conversion factor. Since in the next step you will multiply by 50 / g, the units come out properly.

4C

$$50\ \mu g \times \frac{1\ mg}{1000\ \mu g}$$

Now multiply these two numbers and place your answers in the blanks of 3A.

PLEASE TURN TO 3A

From 3A

Your answer should read as follows:

5A

$$50\ \mu g \times \frac{1\ mg}{1000\ \mu g} = \frac{50\ mg,\ \mu g}{1000\ \mu g}$$

Notice that the μ cancel out leaving the answer in the proper unit, mg. If you got the proper answer or understand your mistake, turn to 8C. If you got the wrong answer or do not understand your mistake, turn to 7B.

From 4B

You should have filled in the blanks in the following way.

5B

1. 1000 g = 1 kg
2. 1000 μg = 1 mg
3. 1000 mg = 1 g

If all your answers agree with these, turn to 8A.

If one or more of your answers do not agree with these, turn to 6C.

5C

From 3C

Ignoring the numbers you are multiplying $\mu g \times \frac{\mu g}{mg}$

You will get $\frac{(\mu g)^2}{mg}$

These are the wrong units, since you are trying to convert μg into mg.

PLEASE TURN TO 6A

6A

From 3C

Had you selected $\frac{1\ mg}{1000\ \mu g}$ then you would multiply $50/g \times \frac{1\ mg}{1000\ \mu g}$

The units would read $\frac{\mu g,\ mg}{\mu g}$

The μg would cancel out, leaving only mg, the correct unit.

PLEASE RETURN TO 8A AND SELECT THE OTHER ANSWER

6B

From 4A

There are two units that are commonly used which are smaller than the gram. These are the milligram and the microgram. Based on your knowledge of metric length, select one of the following statements:

1. A microgram is 1/1000 of a gram:

TURN TO 2C

2. A microgram is 1/1,000,000 of a gram.

TURN TO 1B

6C

From 5B

You missed one or more of the answers when asked about conversion factors. This means that you have not memorized the units, or do not understand the problem properly. You must actually memorize the units involved. You must know the number of milligrams (mg) in each gram, the number of micrograms in each milligram and the number of grams in each kilogram.

PLEASE TURN TO 7C

7A

From

Did you get 0.05 mg? This is teh correct answer. Don't forget your units. If you got the wrong answer, chech your division.

50 / g - 0.05 mg

END OF PROGRAM

7B

From 5A

If you selected the wrong answer, you probably either multiplied incorrectly, or used your units improperly. If your units were incorrect, turn to 3C. If your numbers were wrong, you may not know how to multiply fractions. The following examples and answers may help you. To multiply fractions, one denominator is multiplied by the other and one numerator by the other.

numerator $\frac{1}{5} \cdot \frac{6}{9} = \frac{6}{45}$
denominator

Can you do these:

(a) $\frac{1}{7} \cdot \frac{3}{7}$ _____

(b) $\frac{3}{4} \cdot \frac{2}{1000}$ _____

PLEASE TURN TO 8B

7C

From 6C

Here is the relationship shown in a different way.
1 microgram (/ g) x (1000) = 1 milligram (mg) x 1000 =
1 gram x (1000) = 1 kilogram (kg)
If you remember the order / g -- mg -- g -- kg and know that you multiply by 1000 each time you will have memorized the units.

NOW RETURN TO 5B

IF YOU WANT 8A, 8C, and 8B, YOU'LL HAVE TO GET AFTER THE TEACHER.

Information Sources and Activities

If you were asked to find the shortest distance between two points, you would probably obtain a ruler and measure a straight line between the two points. If you were born in the United States, you would measure the distance in miles, feet, yards, or inches, using the unit most convenient for the length of the line.

If you were born practically anywhere else in the world, however, you would use kilometers, meters, centimeters, or millimeters to measure the same line. In addition to being used throughout most of the world, the metric system has several advantages over the American System. First, the metric system has names for units which are much smaller than an inch. Some of these units are smaller than $\frac{1}{100,000}$ of an inch. In biology, where microscopes are commonly used, these small units are convenient. Secondly, metric units are easier to use than American units because they are all related by a factor of 10. Finally, throughout the scientific world the metric system is used exclusively. In order for you to understand biological measurements, therefore, you must understand the metric system.

INSTRUCTION

Program 3-1

Before you can use the metric system, you must know the basic units. Do not try to compare the metric system with the American system. Instead, learn it from "scratch," the same way you originally learned to measure.

Obtain a meter stick from the stock room. Place it on the table in front of you, being sure that the side with the metric calibrations is up.

	1. The total length of this stick represents 1 meter. The meter is the basic unit of length in the metric system.
	2. Each meter may be divided into smaller units. On the meter stick, there are divisions which may be read as 10, 20, 30, 40, etc. These are called decimeters. Thus, there are 10 _____ in each meter.
decimeters	3. Inside of each decimeter, there are 10 numbers 1,2,3,4 etc. These numbers represent units of measurement known as centimeters. There are 10 _____ in each decimeter, and _____ centimeters in each meter.
centimeters 100	4. The smallest division on the meter stick is known as a millimeter. There are 10 millimeters in one centimeter. There are _____ millimeters in a decimeter, and there are _____ millimeters in a meter. Notice that the prefixes for each of these units are based on the meter. Deci- means 1/10th, centi- means 1/100, (a cent is 1/100th of a dollar), and milli- means 1/1000th.

100 1000	5. So far we have said that 10 millimeters (mm) make 1 centimeter (cm). 10 cm make 1 decimeter (dm) and 10 dm make 1 meter (M). If we were to express these units as fractions, a dm would be _____ of a meter; a cm would be _____ of a meter, and a mm would be _____ of a meter.
1/10 1/100 1/1000	6. There are also three smaller divisions which we must consider, which are not shown on your meter stick. The first of these is a micron, abbriviated by the Greek letter mu (μ). A micron is 1/1000th of a mm. Thus, there are _____ microns in a millimeter.
1000	7. The next unit is a millimicron or 1/1000th of a micron. There are _____ millimicrons (mμ) in a micron and 1,000,000 millimicrons in a _____.
1000 millimeter	8. Although there are no μ divisions on your ruler, special rulers are available which can be used under the microscope. These are divided into divisions which are a μ long.
	9. The final small division is called an angstrom(Å). An angstrom is 1/10th of a mμ long. There are _____ angstroms in a mμ. There are _____ μ in a mm. There are _____ mm in a M, _____ cm in a dm, and _____ dm in a M. There are _____ mμ in a μ.
10 1000 1000 10 10 1000	10. These are all of the metric units with which you need to be familiar. The following table summarizes the above information.

METRIC CONVERSION

/Table 3-1/

This table shows the number of units in the vertical columns which may be found in the horizontal rows. Fill in the units.

Metric Linear Unit

Number of these units in 1 of the metric linear units.

	Å	mμ	μ	mm	cm	dm	M
Å	1	10					
mμ	1/10	1					
μ			1				
mm				1			
cm					1		
dm						1	
M						1/10	1

The completed table may be found in he answer section of this chapter. If you cmpleted this table without looking at the table in the answers, you understand the metric units. If you could not complete the table, you should memorize the following:

/Table 3-2/

CONVERSION FACTORS

1 M = 10 dm
1 dm = 10 cm
1 cm = 10 mm
1 mm = 1000 μ
1 μ = 1000 mμ
1 mμ = 10 Å

This is the information you must know in order to convert from one metric unit to another.

A conversion is made in the following manner. If you follow the steps in order, your answer will always be correct. Notice that the units are very important because they let you know if you have done the problem properly.

The following are examples of how to convert both correctly and incorrectly. If these examples are understood you should never make a mistake in a conversion problem.

Problem: 6 mm = ? μ or How many microns are there in 6 mm?

Step 1 Choose the proper conversion factor from Table 2-2. This will be the factor which contains the two units involved in the problem, in this case mm and μ.

From the table: 1 mm - 1000 μ

Step 2 Express the conversion factor as two fractions, one with the mm on the bottom and one with the mm on the top. Be sure to include both the numbers and the units.

(a) $\frac{1 \text{ mm}}{1000\ \mu}$ (b) $\frac{1000\ \mu}{1 \text{ mm}}$

Step 3 Multiply each of the fractions by the number given in the problem. Be sure to include the units. In this case, the number given is 6 mm.

(a) $\frac{1 \text{ mm}}{1000\ \mu} \times 6 \text{ mm} = \frac{6 \text{ mm}^2}{1000\ \mu}$ (b) $\frac{1000\ \mu}{1 \text{ mm}} \times 6 \text{ mm} = \frac{6000\ \mu, \text{ mm}}{1 \text{ mm}}$

Step 4 When the units are multiplied together, the millimeters come out as mm^2, since mm X mm = mm^2. The units with which you come out in problem (a) are $\frac{\text{mm}^2}{\mu}$. These are not the units you want, because you are trying to convert to μ.

In problem (b) the units are $\frac{\mu, \text{ mm}}{\text{mm}}$

Here the mm will cancel out of the problem since they are both in the denominator and numberator. Thus, you are left with / , the unit you want.

(a) $\frac{1 \text{ mm}}{1000\ \mu} \times 6 \text{ mm} = \frac{6 \text{ mm}^2}{1000\ \mu}$ (Wrong units: this is not satisfactory.)

(b) $\frac{1000\ \mu}{1 \text{ mm}} \times 6 \text{ mm} = \frac{6000\ \mu, \text{ mm}}{1 \text{ mm}}$ (mm cancel out; This is correct answer.)

$= 6000\ \mu$

Program 3-2

Now try this problem: 40 mm = ? cm

	1. Select conversion factor. _____
1 cm = 10 mm	2. Express the conversion factor as fractions being sure to include the units. (a) _____ (b) _____
(a) $\frac{1\ cm}{10\ mm}$ (b) $\frac{10\ mm}{1\ cm}$	3. Multiply the units and numbers by number and units in problem. (a) $\frac{1\ cm}{10\ mm}$ X _____ (b) $\frac{10\ mm}{1\ cm}$ X _____
(a) 40 mm (b) 40 mm	4. Write the answers in the proper place and cancel out units. (a) $\frac{1\ cm}{10\ mm}$ x 40 mm = _____ (b) $\frac{10\ mm}{1\ cm}$ x 40 mm = _____
(a) $\frac{40\ cm,\ mm}{10\ mm}$ (b) $\frac{400\ mm^2}{cm}$	5. Divide out problems and choose proper answer. (a) $\frac{40\ cm}{10}$ = _____ (b) $\frac{400\ mm^2}{cm}$ = _____
(a) $\frac{4\ cm}{1}$ (b) $\frac{400\ mm^2}{cm}$	6. Select proper answer, remembering that the problem shows cm as the desired unit. _____
4 cm	

If you desire to make a conversion of a unit such as mm to dm, you will not be able to find the proper conversion factor in Table 3-2. In this case, you can either use the factors from Table 3-1, or go through the conversion process twice. The first time, concert mm to cm. Then convert cm. to dm, and you will have the proper answer.

Activities:

Unitle you can use the metric system, you cannot do many activities in biology. Therefore, the activities in this chapter will be limited to measuring and converting. The answers to the conversion problems in this section can be found in the answer section of this chapter.

1. Measure yourlab partner's height in meters. _____

   How tall is your lab partner in dm? _____

   in cm? _____

   in mm? _____

   in μ? _____

   in mμ? _____

   in Å ? _____

2. Using your meter stick, measure the length of your lab table. How many mm long is it? _____

   How many cm? _____

3. Obtain some plant specimens from the stock room or herbarium. Measure the lengths of the specimens. The answers will be written on the sheets on which the plants are mounted.

   How many cm long are the plants? _____

   How many mm? _____

   How many M? _____

metric linear unit

	Å	mμ	μ	mm	cm	dm	M
Å	1	10	10,000	10,000,000	100,000,000	1,000,000,000	10,000,000,000
mμ	$\frac{1}{10}$	1	1,000	1,000,000	10,000,000	100,000,000	1,000,000,000
μ	$\frac{1}{10,000}$	$\frac{1}{1000}$	1	1,000	10,000	100,000	1,000,000
mm	$\frac{1}{10,000,000}$	$\frac{1}{1,000,000}$	$\frac{1}{1000}$	1	10	100	1,000
cm	$\frac{1}{100,000,000}$	$\frac{1}{10,000,000}$	$\frac{1}{10,000}$	$\frac{1}{10}$	1	10	100
dm	$\frac{1}{1,000,000,000}$	$\frac{1}{100,000,000}$	$\frac{1}{100,000}$	$\frac{1}{100}$	$\frac{1}{10}$	1	10
M	$\frac{1}{10,000,000,000}$	$\frac{1}{1,000,000,000}$	$\frac{1}{1,000,000}$	$\frac{1}{1000}$	$\frac{1}{100}$	$\frac{1}{10}$	1

ANSWERS /Table 3-1/

Activity 4:

ANSWERS

(a)	50
(b)	0.7
(c)	40
(d)	32,000
(e)	4,800
(f)	170
(g)	2.9
(h)	140,000

INSTRUCTION PART II

Now let's see how well you can transfer what you have learned about metric units of length to metric units of mass. You will find that the prefixes for the various units are much the same. Work a few of the self-appraisal items at the end of Instruction Part II. If you have difficulty, work through Program 3-3 and them try the self-appraisal items again.

1. Solve the following problems:

(a) 5 g = _____ μg

(b) 7 mg = _____ kg

(c) 400 μg = _____ kg

(d) .37 kg = _____ g

(e) 65 mg = _____ g

(f) 2.3 g = _____ mg

(g) 113 μg = _____ g

PART II

ANSWERS

1. (a) 5,000,000

   (b) .000007

   (c) .0000004

   (d) 370

   (e) .065

   (f) 2,300

   (g) .000113

2. List five careers where measurement is used.

References: BSCS Laboratory Guide

UNIT III

Scales and Magnification

Rationale:

How often have you observed photograph or drawing of a plant or animal and wondered just how big the organism really is? If a person who had only seen small birds such as sparrows and hummingbirds saw a picture of an American eagle, he would probably assume it to be of similar size. Properly labeled illustrations either state the magnification or have a scale line, like on a map. The former can be used to calculate the actual size of the object illustrated, while the latter indicates this size directly.

Objectives:

15. Apply a rule to determine the size of an object on the basis of a picture of the and the magnification of the picture.

16. Apply a rule to determine the size of an object on the basis of a picture of the object and a scale for the picture.

16A. Tell about one career of your choice using these areas as a guide limit:

1. Where does one get the skills?
2. How and where do you apply?
3. What exactly would you do the job?

Review of the Method for Solving the Two Types of Problems

1. Write down the rule.

2. Measure the size of object (or part of the object) in the picture with a ruler and plug this value into the equation.

3. Plug the other known value into the equation.

   A. If it's the magnification, it's given.

   B. If it's the actual size, you must determine it using the scale line as a ruler. (This will be one of the answers.)

4. Solve the equation from the unknown value (either magnification or actual size.) Keep all your units the same (all in cm or all in mm, etc., don't divide cm by mm, for example).

   Reminder: When you use a ruler to measure the picture, you are measuring the PICTURE SIZE. When you use the scale line as a ruler to measure the picture, you are measuring the ACTUAL SIZE.

Activity II

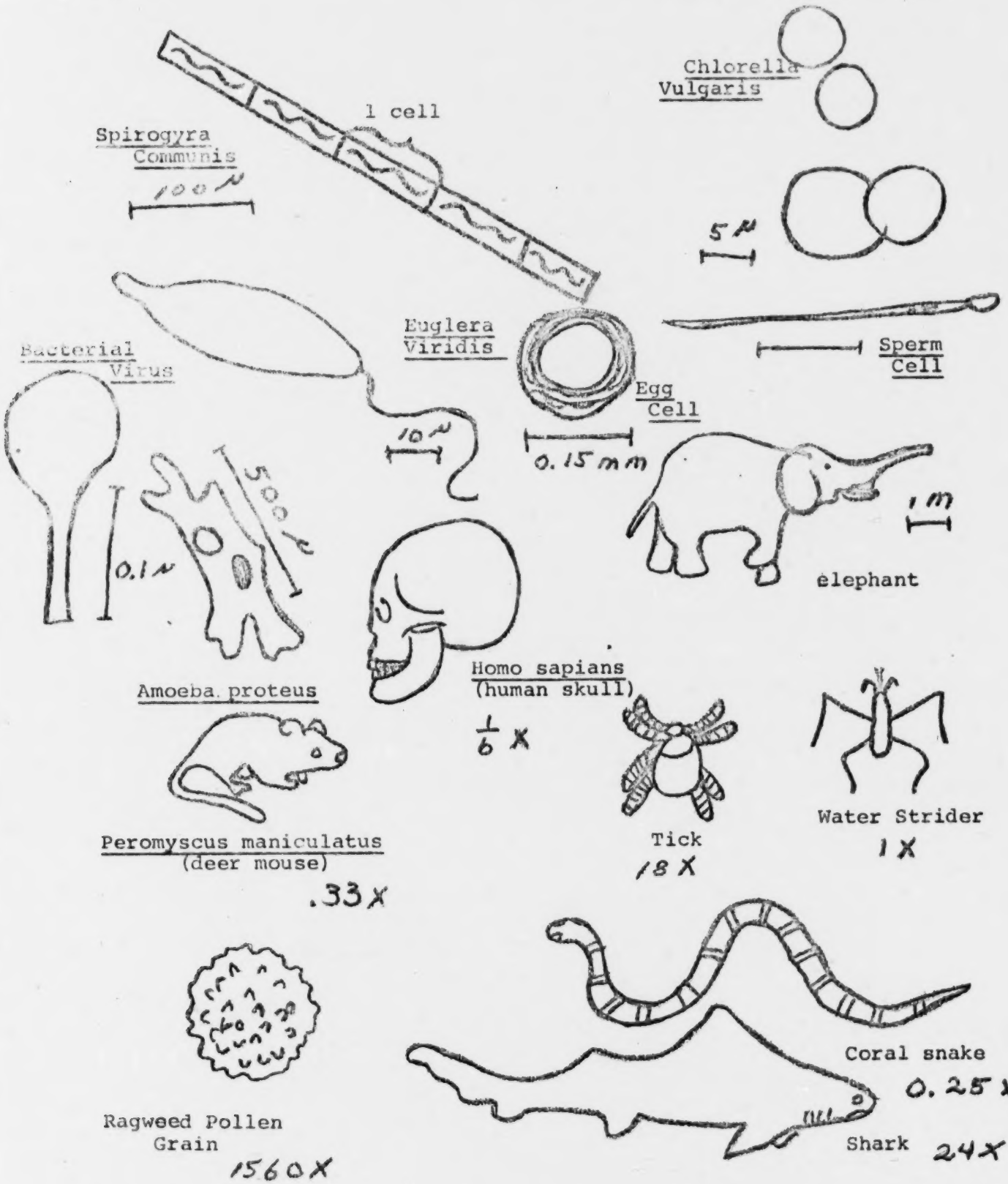
1. Objective: Practice drawings

1. On the page 40 are some practice problems for both types of problems. Work only enough problems to give you confidence that you are competent. The answers are given at the end of the unit. You can plug the fractional magnifications directly into the equation or convert them to decimals first. Answers are on page 45. Show all your work in detail.

2. Review filmstrips in Foundations for Occupational Planning SVE.

Final Evaluation: Show completed activities to teacher and take evaluation given to you.

SELF TEST


Chlorella Vulgaris
1 cell
Spirogyra Communis
100 μ
5 μ
Sperm Cell
Euglera Viridis
Egg Cell
Bacterial Virus
10 μ
0.15 mm
1 m
elephant
0.1 μ
500 μ
Amoeba proteus
Homo sapians (human skull)
1/6 X
Peromyscus maniculatus (deer mouse)
.33 X
Tick
18 X
Water Strider
1 X
Coral snake
0.25 X
Ragweed Pollen Grain
1560 X
Shark
24 X

Activities and Information Sources

(Objective--Determining the Actual Size and magnification of an object in a picture.)

A picture of a plant or animal will communicate more to you if it indicates the objects actual size. The two common methods of doing this use either (1) the magnification or (2) a scale line like that on a map.

The following diagrams show a common insect known as a Water Strider illustrated at three different magnifications.

1X

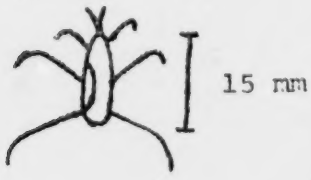
0.2X

2X

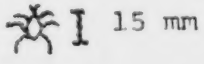
In A the insect is shown 1 times its actual size. This means that this diagram is life size, that is, it could have been made by placing the living insect on the paper and tracing around it. The next diagram (B) shows the insect 0.2 times of its actual size. Thus this picture shows the insect smaller than it actually is. Showing something smaller than actual size is most useful when illustrating large objects such as a sparrow, a pine tree, dog, etc. The final diagram (C) shows the insect 2 times or twice its actual size. Showing an object larger than actual size is most useful for illustrating very small or microscopic objects.

The next three diagrams show the insect at the smae three magnifications as before. This time, however, size is indicated by a scale line.

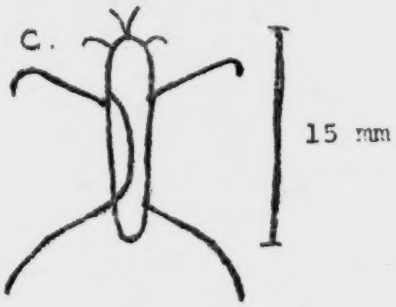
A.

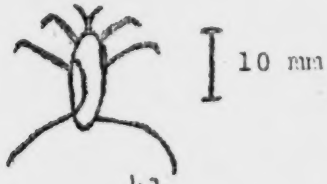


B.



C.





In the top three drawings, you will note that the scale line indicates that the actual size of the organism is 15 mm, in all cases. Now, figure the actual size of the lower insect using the scale line provided. If you came up with 15 mm, you are correct.

You will learn to solve two types of problems in this unit. In both types you will utilize the following rule:

$$\frac{\text{PICTURE SIZE OF THE OBJECT}}{\text{ACTUAL SIZE OF THE OBJECT}} = \text{magnification}$$

This rule should be easy to remember since magnification is obviously the relationship between the actual size of an object and the magnified (or reduced) size of the object. The problem is to remember which of these is divided into the other. Actually, this presents no great problem since the answer will not seem logical if you do it incorrectly.

Type I Sample Problem

The only thing you will be given is the magnification of the picture. You will be asked to find the actual size of the object or a part of the object. First, write down the rule. Second, use a ruler to determine the picture size of the object or part of the object. Third, plug your two known values into the equation and solve for the actual size. For example, what is the actual size (length) in mm and microns of the cell diagrammed below?

1000X

Answer:

The magnification is given as 1000X. When you measure the cell you will find that it is 50 mm long. Therefore:

$$\frac{\text{PICTURE SIZE}}{\text{ACTUAL SIZE}} = \text{MAGNIFICATION} \qquad \frac{50 \text{ mm}}{\text{ACTUAL SIZE}} = 1000$$

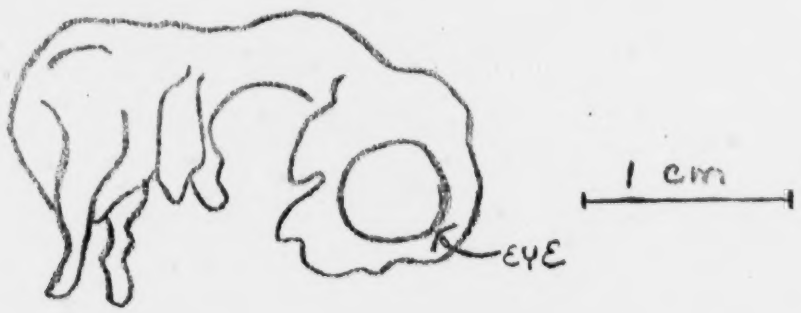
$$(\text{ACTUAL SIZE}) \times (1000) = 50 \text{ mm} \qquad \text{ACTUAL SIZE} = \frac{50 \text{ mm}}{1000}$$

ACTUAL SIZE = 0.05 mm or 50 μ long

The problem could just as well have asked for the actual width of the cell rather than the length. In this case you would have measured the width of the cell (10 mm) and used it in the equation instead of the length.

Type II Sample Problem

The only thing you will be given is a scale line next to the picture. You will be asked to find both the actual size of the object or a part of the object and the magnification of the picture. First, write down the rule. Second, use a ruler to determine the picture size of the object or part of the object. Third, use the scale line like a ruler to determine the actual size of the object or part of the object. Fourth, plug your two known values into the equation and solve for the magnification. For example, look at the diagram of a developing chick embryo shown below. What is the (A) diameter of the eye of the living embryo and (B) what is the magnification of the diagram?



Answer:

Using a ruler you should find the picture size of the eye to be 1.5 cm. Uisng the scale line like a ruler, you will find that the eye is half as long as the scale therefore, the actual size of the eye is 0.5 cm (answer to A). To solve for B ---

$$\frac{\text{PICTURE SIZE}}{\text{ACTUAL SIZE}} = \text{MAGNIFICATION} \qquad \frac{1.5 \text{ cm}}{0.5 \text{ cm}} = \text{MAGNIFICATION}$$

$$3 = \text{MAGNIFICATION}$$

ANSWERS TO ACTIVITY PROBLEMS:

OBJECT PICTURED	ACTUAL SIZE	MAGNIFICATION
Spirogrya communis	80 μ (length of 1 cell)	250X
Chlorella vulgaria	6-10 μ (diameter)	2000X
Euglena viridis	53 μ (not including flagellum)	1000X
T4 bacterial virus	0,2 μ (length)	260,000X
Amoeba proteus	720 μ (longest dimension)	65X
Peromyscus maniculatus (deer mouse)	9.3 cm (body length)	0.33X
Homo sapiens (human skull)	24 cm (longest dimension)	.16X
elephant	3.4 m (high)	$\frac{1}{120X}$
tick	0.8 mm (body length)	18X
water strider	15 mm (body length)	1X
coral snake	47 cm (length)	0.25X
ragweed pollen grain	17 μ (diameter)	1561X
shark	2.3 m (length)	$\frac{1}{24X}$
human egg	0.15 mm (diameter)	133X
human sperm	35 μ (length)	2000X

UNIT IV

HOW TO SEE OR USING A MICROSCOPE

Rationale:

The microscope is a standard instrument used by many biologists. Even children who do not grow up to be biologists or take a course in biology may have occasion to use a microscope since inexpensive, plastic microscopes of surprising quality are now available for use even in elementary schools. What a fascinating experience it can be for a child to look for the first time at the teaming microscopic life in a drop of pond water.

As commonly as microscopes are used, however, they are often used improperly. This can cause one to have a truly dull and unrewarding experience. Few persons learn how to use a microscope as a measuring instrument. Diagrams or photographs of microscopic objects are much more informative if some idea of actual size is given. The activities in this unit should enable you to properly use and measure with a microscope.

Objectives:

17. Demonstrate the technique for preparing an unstained or a stained wet mount.

18. Apply a rule to calibrate the field of vision of a microscope.

19. Demonstrate the measurement of microscopic objects with a microscope and a ruler.

19A. List three skills and three separate careers in the field of Health and Marine Science which use the microscope.

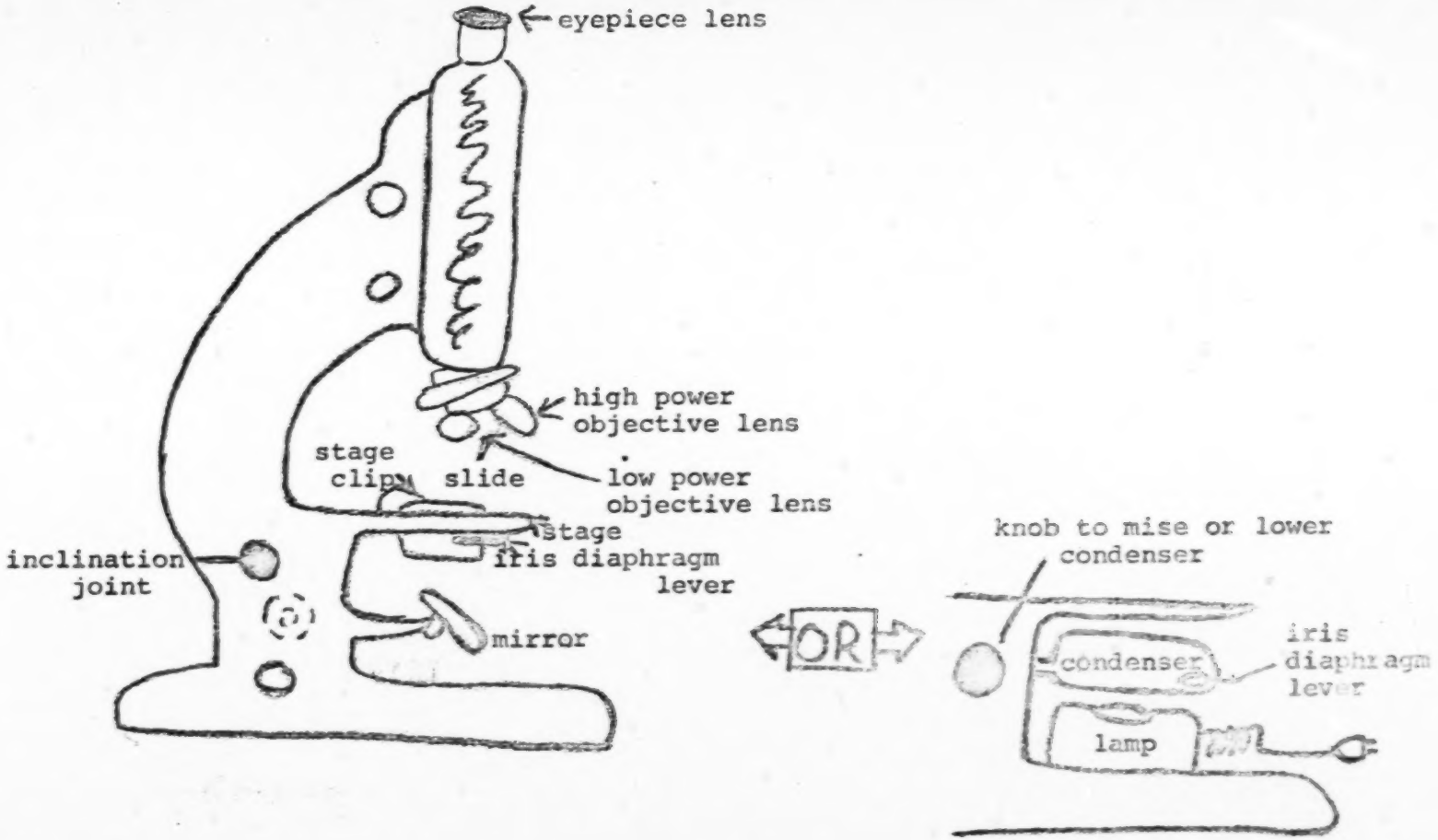
Information Sources:

(see diagrams on the following page.)

You can never be sure what kind of an instrument you will have when you next use a microscope (either for a Biology 12 competency or when you start teaching.) Therefore, it is imperative that your attitude toward a microscope be one of confidence and curiosity. Find out what all the parts do! (Just use reasonable care and don't remove any screws or take the lenses apart.)

The Functional Parts of a Microscope

( ) = possible location of focusing knob(s)



Activity I

Give a brief oral report to class on skills and careers in Health or Marine Science (or both).

Activity II - Getting Acquainted with a Microscope

Obtain a microscope and place it on the table in front of you. A microscope will always have (1) a lens system and the means to focus it, (2) a stage on which to place the slide, and (3) a light source and means of regulating it.

Locate the objective lens or lenses. They can usually be removed (unscrewed) but this should only be done when replacing one with a lens of different magnifying power or for maintenance. Most lenses are marked as to their magnifying power. The low power (shorter) objective is marked 1._____X. The higher power (longer) objective is marked 2._____X. (There may also be a special 100X oil immersion lens.)

Locate the eyepiece lens. Remove it. It is marked 3._____X. Always carry a microscope upright since the eyepeice may fall on the floor. The eyepiece lens further magnifies the magnified image formed by the objective lens.

The total magnifying power of a microscope is usually expressed as the number of diameters an object is magnified and is obtained by multiplying the magnifying power of the eyepiece lens times that of the objective lens used. When a 10X eyepiece and 10X objective (low power) are used, the total magnification is 4._____. This means that an object which is 0.01 mm in diameter would appear to be 5._____ in diameter. If you used the 40X objective (high power), the total mafnification would be 6._____ and the 0.01mm object would appear to be 7._____ in diameter.

To focus the lenses on a specimen, some means must be available which either moves the lenses or the stage (depending on the scope) up and down. Watch the lens tube and stage as you turn the knobs to see which knob, or knobs, does the focusing. If there are two focusing knobs, one is for coarse focusing and the other is for fine focusing.

Not the stage of the microscope. Ths clips keep a slide in position, even when the scope is accidently jiggled and give you more control when you are moving a slide around searching for a specimen.

Now locate all the parts having to do with providing or regulating light. They are usually located below the stage and direct the light upwards <u>through</u> the specimen. Since a specimen is usually viewed with 8._____ (transmitted, reflected) light it is important to use 9._____ than thick "globs" of it. Otherwise little light will get through the specimen and all you'll see is a dark shape without any detail.

Some scopes (including the stereoscopic dissecting microscope discussed later) can also be used with reflected light, that is, the light is above the stage and is reflected from the specimen up to the lenses.

If the scope has a mirror, then its angle must be adjusted so that the light from a lamp or window is reflected through a hole in the stage and evenly and brightly illuminates the entire field of vision. Never use direct sunlight since this will hurt your eyes. If the scope has a built-in camp, make sure it is plugged in. If the light is still not on, it probably has an on/off switch which must be turned on (or else the bulb is burned out).

Find the iris diaphragm lever. Moving it back and forth varies the size of the opening through which the light passes much as the iris of your eye adjusts (automatically) to allow the proper amount of light through the pupil into the lens. Some scopes also have a light condenser below the stage. The iris diaphragm is then usually part of the condenser. The height of the condenser can be adjusted with a knob so that the light passing into the condenser can be focused on the slide. Once the light is focused, the intensity can be increased or decreased using the iris diaphragm lever.

Some scopes have an inclination joint so the instrument can be tilted toward you for more comfortable viewing.

Steps to Follow in Using a Microscope

1. Always start with the low power objective in position since (A) you get a better overall view of the specimen, (B) you can more easily locate it (unless it is really small), (C) and you don't have to try to focus initially with the longer high power objective, which may be accidentally rammed through the slide and broken. A few microscopes have "stops" to prevent the latter.

2. (A) Open the iris diaphragm fully. If there is a mirror look into the scope and adjust the mirror angle until the field of vision is evenly and brightly illuminated.

(B) If there is a built-in lamp, turn it on.

(C) If there is a light condenser, adjust it as follows: Place a slide on the stage. Close the iris diaphragm down until you can see its outline while looking in the scope. Adjust the condenser height with the knob provided until the diaphragm outline just shifts from a blue to a green hue.

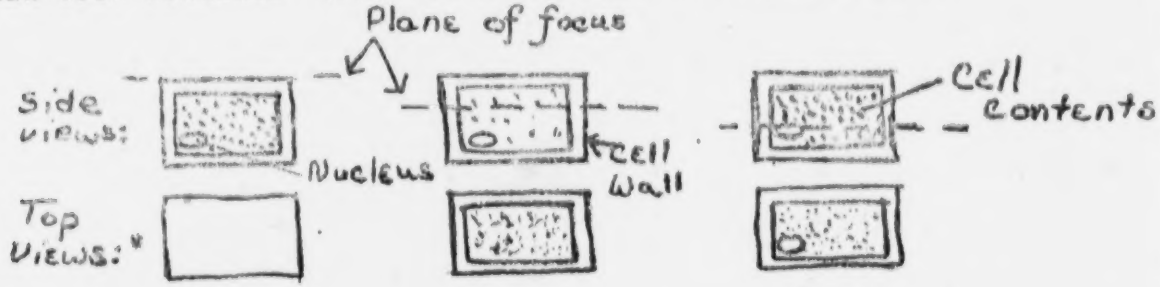
3. Place a slide on the stage. If the specimen is visible with the naked eye (macroscopic), move the slide while looking from the side until specimen appears to be centered below the objective. Focus on the specimen. It is a good idea to always start with the objective close to the slide and focus upwards.

4. Adjust the iris diaphragm to the point where you can see the most detail in your specimen. You will probably never work with the diaphragm fully open because of the glare and possible eye strain.

5. Flip over the high power. The specimen should be in focus. If it is not, move the focusing knob back and forth slowly until you see the specimen clearly.

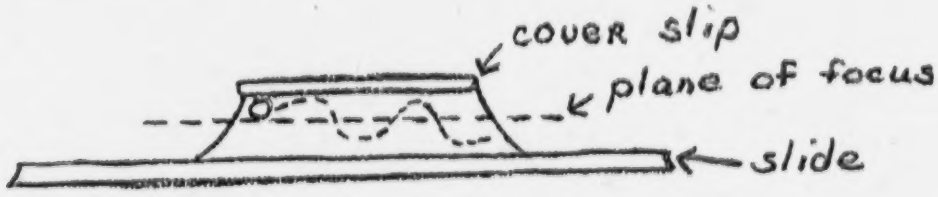
6. If there is both a coarse and a fine focusing knob, use the coarse focusing on low power when initially focusing and the fine focusing for obtaining critical focus. Use only the fine focusing on high power or you may ram the objective through the slide.

7. Slowly move the focusing knob (if there is only one, or the fine focusing knob if there is both a fine and coarse focus) back and forth very slowly when examining a specimen in detail. This allows you to "see the object in depth." What you are doing is moving the plane of focus to different levels of the specimen. If you were looking at the cell in the diagram below, for example, at one plane of focus you would see the cell wall (A) at another the the main cell contents (B), and at another the nucleus (C).



(*What you see in the scope).

If you were focusing down through a leaf of a water plant like Elodea and observed one cell come into and out of focus and then another cell in the same spot does the same thing, you would conclude that there are at least 10._____ of cells. If you look at a moving organism in a drop of pond water, you will probably have to shift focus continually to keep it in view since the organism moves up and down out of the plane of focus:



8. Helpful hints:

   A. A drop or two or 10% methyl cellulose (a very viscous or thick liquid) will slow rapidly moving organisms down so they can be more easily observed.

B. Keep both eyes open, especially if you plan to use the scope for a long time. This relieves eye strain.

C. When making sketches from a scope, observe with your left eye if you're right handed. This allows you to look at a sheet of paper with your right eye and make a sketch while simultaneously viewing the specimen in the scope.

D. If the lenses or mirror is dusty, remove the dust by blowing or with a soft brush. Using lens paper on a dusty lens will produce scratches. To remove grease or fingerprints, remove the dust first, then use a piece of lens paper (it's lintless) and, if abailable, a drop of lens cleaner.

Activity II - The Characteristics of a Microscopic Image

Obtain a prepared slide with the letter "e" on it. Focus on the letter under low power. The image you observe is 11._____ (inverted, right side up). When you move the slide to the right, the "e" and slide appear to move to the 12._____. When you move the slide away from you, the letter"e" and slide appears to move 13._____. If you were to look at this diagram - - through a microscope, it would appear as follows: 14. _____. Note the apparent size of the letter "e" and the area of the field of vision under low power (10X objective in place). Now switch to high power (40X objective in place). The letter "e" appears to be approximately 15._____ times or 16. _____ diameter larger and the field of vision is only 17._____ as large as it was.

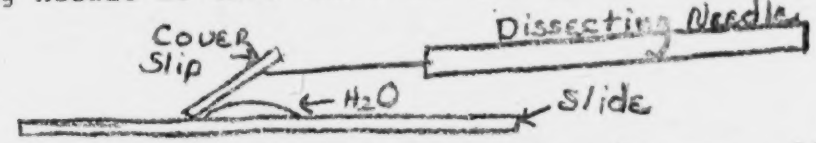
Activity III - Preparing a Wet Mount and Staining

Sometimes prepared slides are available, but more often you need to prepare a slide for yourself. The following directions suggest some simple procedures for making water mounts of microscopic objects. These are temporary mounts which dry ou and cannot be saved.

1. Preparation of a wet mount of a microscopic object(s).

   A. Draw up a few drops of the water containing the minute objects in an eye dropper or disposable pipette.
   B. Tap the side of the dropper containing the minute objects slightly above the water level to help settle the objects to the dropper end.
   C. Place a drop of the watery mixture on the center of the slide.
   D. Carefully position a cover slip to that one edge of it just touches the edge of the drop of watery mixture.

E. Slowly lower the cover slip with the tip of a dissecting needle so that there are few or no air bubbles.



F. If there is insufficient water under the cover slip, add a drop.
G. Blot up any excess moisture on the slide and place the slide on the stage.

2. Wet mount of a macroscopic object(s).

A. Place the object on the slide. If the material is filamentous (threadlike) like many of the common water plants called algae, use a forcep to place a thread or two on the slide.
B. Place one, two, or three drops of water on the object, depending upon its thickness.
C. Follow steps D, E, F, and G above.
D. Gently tap the cover slip to drive out any air bubbles that remain.

3. Staining a specimen.

If the slide isn't already made, merely add a drop or two of stain to the material to be observed before adding the cover slip. If the material is macroscopic and can be kept in place on the slide, you can stain the object, then rinse off the excess stain with a few drops of water, and add a cover slip. The stain will "stick to" any material in a cell which it is attracted to (stain) and thus the excess stain serves no purpose. This procedure gives the object better contrasts since you don't have to look through a colored stain solution to see the object.

4. Drawing a liquid (stain or some other solution) under a cover slip.

A. Place a drop of the liquid to be drawn under the cover slip next to the edge of the cover slip so the drop actually touches the edge.
B. Gently place a piece of lens paper, Kleenex, or paper towel against the opposite edge of the cover slip so that the water is absorbed from under the cover slip. If more of the new liquid is needed, add more drops to the side opposite the paper "wick." If you want to test the immediately observable effects on cells of s say, a 10% salt solution, you can use the above procedure while looking into the scope.

Activity IV - The Microscope or a Measuring Tool

Place the special slide with a metric scale (marked in mm) or a clear plastic metric ruler on the stage of a microscope. The diameter of the field of vision of our scopes (A.O.) measure 18._____ mm. Since the "lines" on the scale or ruler appear quite broad and rough in the microscope, you must be careful when you estimate the diameter of the field. The distance from the center of one "line" to the center of the adjacent "line is 1 mm, Count the number of complete mm in the field, then estimate the partial mm to the nearest tenth, and add the two figures together. Once the field is calibrated, you 19._____ (can, cannot) use this data to estimate the size of an object in the field. For example, if an object was one-half as long as the diameter of the field (which let's say measures 1.4mm), the object must be 20._____mm or 21._____ long. You may estimate the size of a cell to be 1/20th the diameter of the field. It may be easier, though, for you to estimate how many cells it would take to extend across the diameter of the field (20). However, if the objects to be measured are very small, you may find it easier to estimate how many would fit across one-half the field (10) and multiply by 2 (2 x 10 = 20). Or you could estimate one-fourth of the field and multiply by 4.

If 20 objects fit across the low power field, each object is 1/20 of the diameter of the field. To calculate the size of one cell, do as follows:

1/20 of 1.4 mm or 1/20 X 1.4 mm or

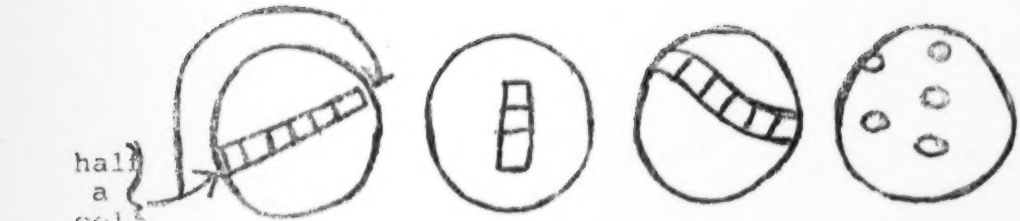
$$\nearrow 0.05 \times 1.4 \text{ mm} = 0.07 \text{ mm}$$

$$\searrow \frac{1.4 \text{ mm}}{20} = 0.07 \text{ mm}$$

You will find the magnification too great under high power to estimate its field size from a mm ruler. You can see only a fraction of a mm. However, you can easily calculate the high power field diameter. Since the magnification with high power is 22._____ greater than with low power (400X vs. 100X), the field of vision under high power is only 23. _____ as large as under low power

$\left(\frac{100X}{400X} = \frac{1}{4}\right)$

If the low power field measure 1.4mm or 24._____ the high power field would be 25._____ mm or 26._____ If l.p. was 100X and h.p. was 440X, then the h.p. field would be $\frac{100}{400}$ or 0.23 of 1.4 mm or 0.32 mm. Now work the practice problems on the next page. Assume that the low power field measures 1.2mm, l.p. is 100X, and h.p. is 400X.



estimated length of one cell in μ: 27.____ 28. ____ 29.____ 30.____

If the cells you are estimating vary in size, you should estimate the length for one which appears to be the most frequent size of the average size. Be sure and state that this is what your estimate represents.

Another way of estimating the size of an object is to compare it to some object in the field of vision of previously determined of known size. For example, you could add some bread mold spores to your wet mount.

Practice measuring one of the organisms listed near the end of this unit.

Activity V - (optional exercise) - Use of an Eyepiece Micrometer for Critical Measuring

For your information, some microscopes have a measuring device called an eyepiece (ocular) micrometer. This can appear as a saw-tooth image in the field of vision. The device has already been calibrated using a special slide marked in tenths of a mm. Each notch is equal to the following values depending on which objective is used:

10X objective - one notch = 50μ
40X objective - one notch = 12μ
100X objective - one notch = 5μ

Practice measuring by finding the length of a single yeast cell or a potato starch grain. Compare your measurement to that obtained by the previous less accurate method.

Activity VI - (optional exercise) - Review of 3-D Shapes

Whatever you observe in a microscope always has 3-D shape. Unfortunately, however, you only see a 2-D representation of it (unless you are using a stereoscopic-dissecting microscope) thus you must infer the 3-D shape. Look at the diagrams of possible microscopic fields below. Name the probable 3-D shapes. Assume that each field contains only one kind of object.

31. _____

32. _____

33. _____

34. _____

35. _____

Activity III

Constructing a Drawing From a Microscopic Object

During your teaching career, you will certainly want to make a drawing of something you have seen with the microscope. The following activity will aid you in this respect, and may help you to grasp the relationship between pictures, magnification, or scales. In this activity you will use yeast cells, but you may use your own blood which you may type at the same time. If you do want to type your blood request the materials from the instructor.

Yeast Drawing

Prepare a wet mount of yeast cells using a drop from the yeast culture (yeast plus sugar and water). Using 400x magnification, measure the diameter of a yeast cell (actual size) with the measuring device (sawtooth) in the eyepiece of your microscope. The distance between each pair of teeth in the sawtooth is 12 microns at this magnification:

1-12m

Make a drawing of a yeast cell so that the drawing is 20 mm across (picture size). Label your sketch with a title and both a scale line and the magnification. Calculate the magnification by using the equation. The magnification should be greater than 400x since the picture you drew is larger than what you observed through the microscope. Note that the yeast cells are easier to see if you reduce the light intensity (using the iris diaphragm). Another way of making them easier to see is to stain them with a little iodine or methylene blue. Try it and see.

Red Blood Cell Drawing

Using a glass-marking crayon, draw two circles on a slide and label them A and B

Wash your hands thoroughly with soap and water. Wipe the tip of one finger with a ball of cotton dipped in 70% alcohol. Let the alcohol dry. Make a small puncture in the tip of your finger with a sterile, disposable lancet. Wipe off the first drop of blood with a dry ball of cotton. Place a small drop of blood in each circle on the slide by touching the slide twice to the tip of your finger. Hold a cotton ball soaked in alcohol over your finger for the rest of this procedure. Immediately place a drop of anti-A

serum on the blood in the circle marked A and mix the two well with a toothpick. Caution: Do not allow the tip of the dropper to touch the drop of blood or the bottle of anti-serum will become contaminated. Place a drop of anti-B serum on the blood in the circle marked B and mix well with the opposite end of the toothpick. Look for a clumping of cells. Now place the slide under a microscope and examine it at 100x, then 400x. Verify whether or not there is any clumping of cells. Discard all used materials in the wastebasket.

If the cells are clumped in A, your blood type is probably A. If the cells are clumped in B, your blood type is probably B. If the cells are clumped in both A and B, your blood type is probably AB. If the cells are clumped in neither A nor B, your blood type is probably 0. Since various other factors influence the results of this test, do not accept your results as positive proof for medical purposes. This can only be done by a qualified medical technician. Note your blood type result on the chart in the laboratory so we can compile the data for this class. Measure and draw a red blood cell using the same method described above for a yeast cell. Cutting the light intensity down with the iris diaphragm will also make the red blook cells easier to see. You need not stain them since they are already colored (with the red pigment hemogrobin.)

Test:

Show assignments and other work to teacher. Then you will be asked to demonstrate skills used in Activity II.

ANSWERS TO ACTIVITY QUESTIONS

Activity I

1. 10X
2. 40X (or 43X)
3. 10X
4. 100X
5. 1 mm
6. 400X
7. 4 mm
8. transmitted
9. very thin
10. 2 layers

Activity II

11. inverted
12. left
13. toward you
14.
15. 4
16. 4
17. 1/4

Activity IV

18. 1.3 - 1.5 mm
19. can
20. 0.7
21. 700
22. 4
23. 1/4 or 0.25
24. 1400
25. 0.35
26. 350
27. 170 μ - 173 μ
28. 50 μ
29. 200 μ
30. 23-32

Activity VI

31. sphere
32. cylinder
33. rectangular box
34. cylinder with a hemisphere on each end
35. cylinder or rectangular box

UNIT V

THIS IS THE LIFE?

Living the Life

Rationale: What's alive? How do you know it is alive? Are you? (sure).

There are no clear answers to these questions but there are ideas, theories and a lot of common sense in understanding life. So the final act of Biology will try to get at these questions and some others.

Objectives:

Student will:

1. Identify organic objects from inorganic objects.
2. Define the classification group Protista.
3. Culture one group of microorganism from three available and describe the growth and reproduction, over a two-week period.
4. List three careers in different areas that have to do with life, one of which must deal with microorganisms.
5. Be able to define the world of work in everything no more than one page 8½" by 11".

UNIT I

Self Test:

1. From ten objects on lab table separate in groups the organic from the inorganic objects.
2. Why are living things placed in the kingdom Protista?
3. What are microorganisms?
4. How does the organism you cultured reproduce?
5. What is necessary in order for microorganisms to be cultured?
6. List three careers which had to do with living things.
7. What is the world of work?

UNIT I

Information Sources:

1. Organic material is from or was or still is alive. Where as inorganic material never was alive? The question mark is because in some cases neither definitions are any good for it is sometimes very difficult to tell which is which. Generally things like rock, air, salt, and water are considered inorganic. Also all the individual elements on the Periodic Chart also would be inorganic. Okay that's easy enough. But you are made up of inorganic elements and you are organic. So look in texts, dictionaries, and the library for more information.

2. Text Book Green Version High School Biology

chapter six and seven also classification page 782 and 783

3.	Filmstrip	Classification	Protozoa EBE
		"	Algae EBE
		"	World of Work SVE

Activities:

1. Read chapter six, do questions 7, 8, 13, 14, - page 212
   Do problems 1 and 3.
2. Do lab 6.1 - page 189 Green Version (Long group lav)
3. Observe prepared slides on selected protest which are with the microscopes at the lab tables.
4. Read chapter seven, answer guide question 1, answer problem 3.
5. Lab 7.1 - page 216 (individual lab)
6. Look at filmstrip on:
   a. Protozoa
   b. Algae
   c. World of Work
7. Write a short paper on three careers in the world of work that deals with life, one of which must deal with micro-organisms.

Final Evaluation:

Have your note book checked to show that activities have been completed. Then take test from instructor (Review objectives first).

Quest:

Lab 6.2 through 6.4. See instructor for help here.

Unit VI

?WHAT IS IT?

Rationale

The method of acquiring a skill for the world of work when you leave high school, whether college or high school, will require continued training and learning. No matter which career you are in, new methods of observing and classifying will be developed. In this unit classification of material is developed. As you know, or will know, classification is important in many careers: for auto supply stores, business, and even for biology--which is what we will study in some detail.

Objectives:

The student should:

5A. Use the library in finding careers in career clusters.

5. Describe one or more members of a set of objects so that another individual will be able to identify or name the object or objects.

6. Construct a multistage classification for a set of objects.

7. Construct a dichotomous key which will enable another individual to name unknown members of a set of objects.

SELF TEST

Given this set of pictures of leaves--

/Figure 2-11/

(a) Identify and name an observable property of these pictures of leaves that could be used to classify them in subsets.

(b) Construct a key for classifying the set of pictures of leaves into ten separate categories, one category for each kind of leaf. Check your classification scheme with the instructor.

The instruction on classifying adapted from: Science - A Process Approach.

Information Sources and Activities:

Once the scientist has thoroughly observed and described the organisms that he is working with, he usually sees the need to group them in some manner based upon their observable properties. If he expands his grouping scheme into a multi-stage form, he can ultimately devise a system that will separate organisms of similiar grouping of organisms so they may be identified. This grouping system can be easily modified into a simple dichotomous key.

There are three important principles in classifying: (1) the system must be useful; (2) the system can be arbitrary; (3) any group of objects or events can be classified in more than one way.

In the process of developing classification systems, the objects are first divided into two subsets on the basis of one observable property. Each subset is further subdivided on the basis of a second observable property, and so on, until individual objects can be identified.

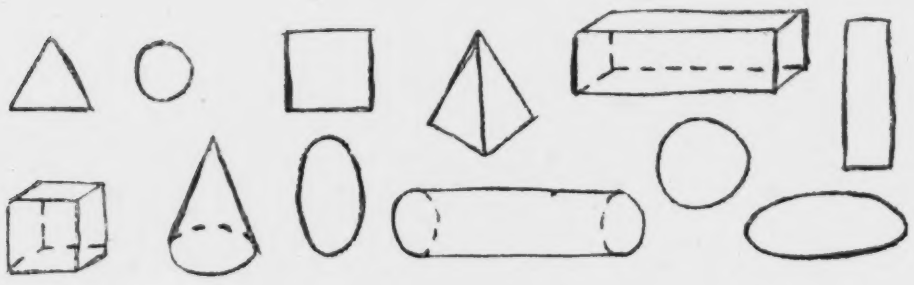
The characteristics that are used in identifying objects can be put into an outline. Such an outline can be organized and used as a key.

INSTRUCTION

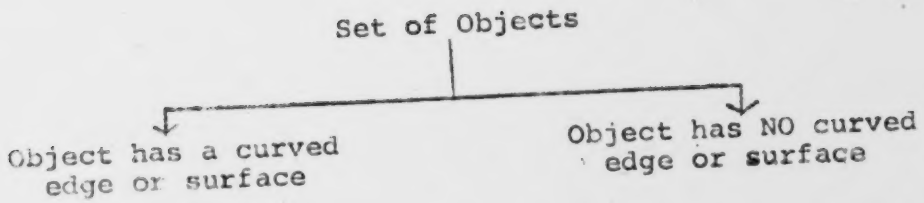
Part I: Grouping

As you describe objects so another individual can identify or name the objects, you are really determining the properties that may be used to classify. Here is a picture of a set of objects. Observe it and make a list of the observable properties (characteristics, features) of the objects.

/Figure 2-1/



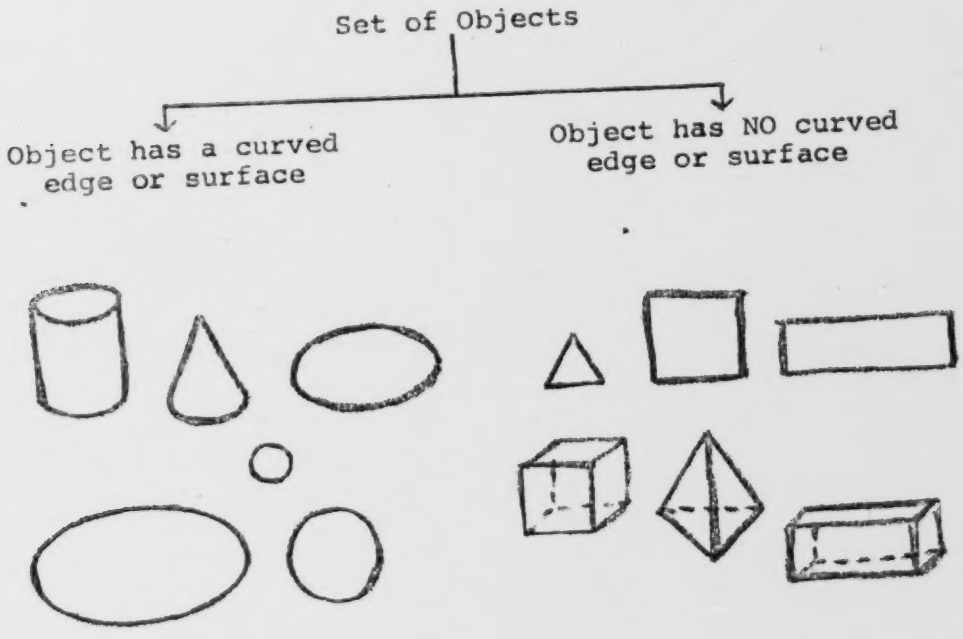
Probably you observed that some of these objects have a curved edge or surface. A one-stage classification could be based on the presence of a curved edge or surface. Of course, all objects without a curved edge or surface belong in a second category or group.



One-stage sorting of the set of shapes could also be based on number of edges or whether the object is two-dimensional or three-dimensional. What other criteria can you think of?

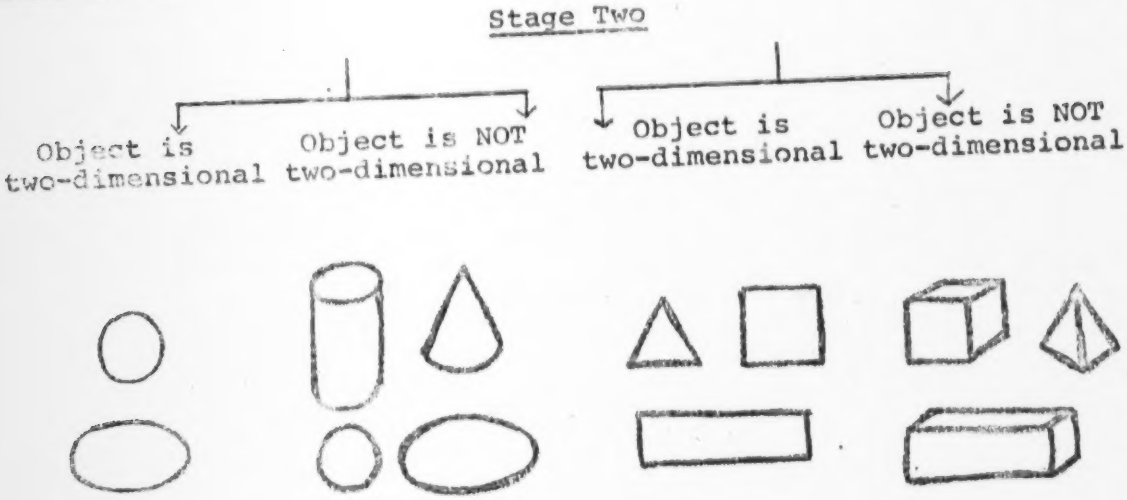
Figure 2-2

Stage One



By sorting the objects on the basis of two criteria, a two-stage classification can be constructed.

Figure 2-3

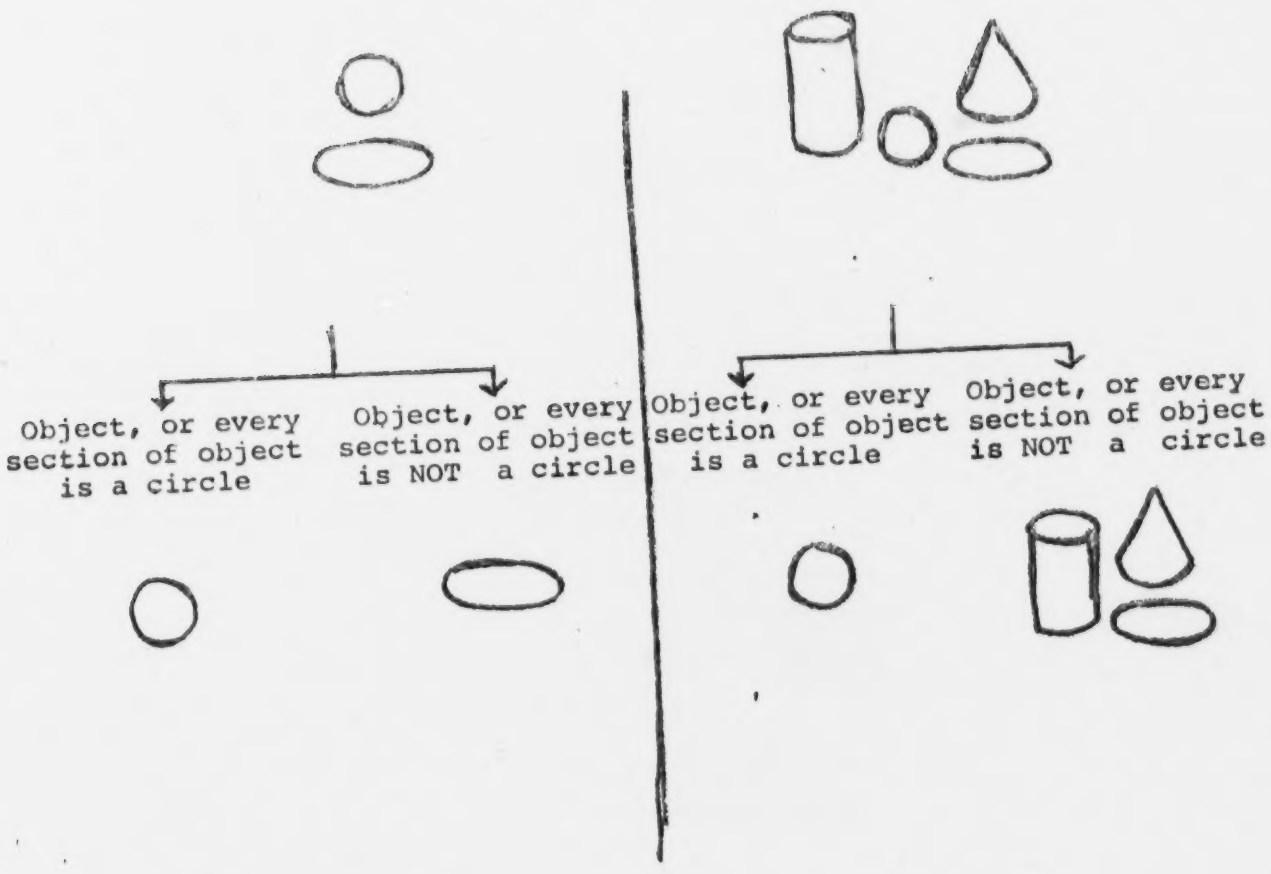


What characteristics might be used to add a third and a fourth stage to this classification scheme? Try is. (Some suggestions are given on pages 11 and 12.)

For the third stage of the classification, different criteria can be used for the sets of curved objects. For example, for the curved objects:

/Figure 2-4/

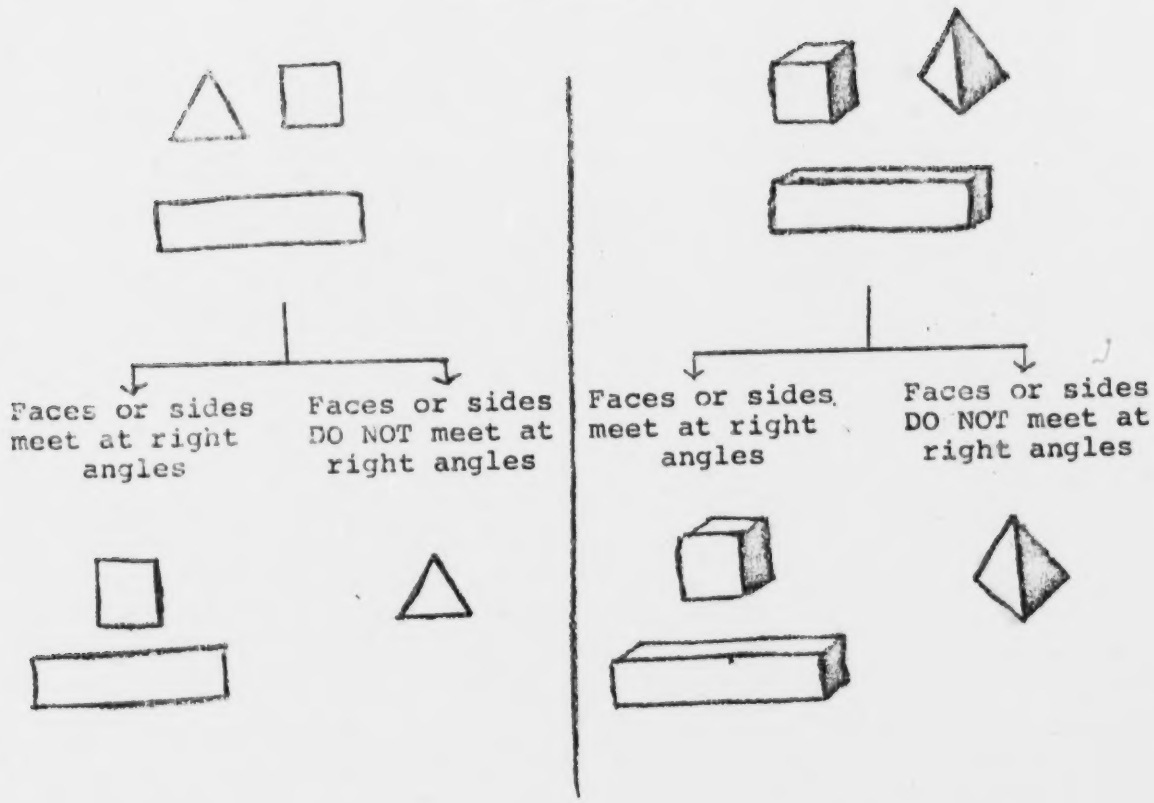
Stage Three


Object, or every section of object is a circle
Object, or every section of object is NOT a circle
Object, or every section of object is a circle
Object, or every section of object is NOT a circle

and for the non-curved objects:

/Figure 2-5/

Stage Three


Faces or sides meet at right angles
Faces or sides DO NOT meet at right angles
Faces or sides meet at right angles
Faces or sides DO NOT meet at right angles

INSTRUCTION

Part II: Keying

In the last section you learned to group objects based on their similarities and differences. In this section you must l learn to arrange these groups into what biologiate call a key. A key is used by biologists to identify unknown animals and plants. If you find a plant and want to know that kind of plant it is, you can use a key to find out.

Below is pictured an object:

/Figure 2-6/

Here is a key which will let you identify the object. Read the statements which follow. Look at ls and lb and see which stement fits the object. Then read over to the end of th line and see what number is given and go to the two statements which begin with that number.

1a - object contains right angles ---------- go to 2

1b - object is made only of curved lines --- go to 3

2a - object has 3 right angles ---------- Knurgle

2b - object has 6 right angles ---------- Coopot

3a - object does not contain any circles --- Flapper

3b - object contains 2 circles ---------- Gluck

If you first chose group 1b you made the proper choice since the object is made up of curved lines and no right angles. State ment 1b refers you to 3. Therefore, you skip the 2a and 2b

statements and go directly to 3. Here you have two choices, 3a and 3b. You should have chosen 3b since our unknown object contains circles. As you should knowknow, the unknown object is a Gluck.

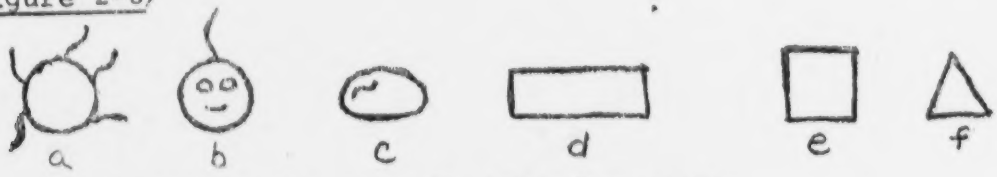
What is the name for the object below?

/Figure 2-7/

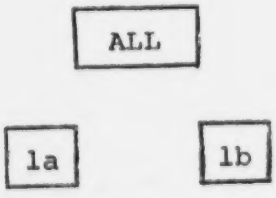
After you have gone through the key, you should know that this is a Coopot (Koo pot). It contains right angles so you go to 2. It has 6 right angles, so it falls into group 2b and is a Coopot.

Now consider how to make a key. To do this you must be familiar with all the objects to be included. Make a key to the following 6 objects:

/Figure 2-8/



First divide the objects into 2 groups:



1a - objects with curved lines ----------

1b - objects with straight lines ----------

When grouping you should use observable characteristics of the types used in the unit on Observation. Notice that the lines following the statements are not yet numbered. Now divide each of the groups, 1a and 1b, into smaller groups. In the second set of numbers, 2a and 2b, let us subdivide group 1a. Since group 1a will be subdivided into groups 2a and 2b, place a 2 after step 1a so that the person following the key will know where to go to find the subdivision.

1a - objects with curved lines ---------- 2

1b - objects with straight lines ----------

Now we subdivide group 2a:

2a - objects made up of circles ----------

2b - object is elliptical ----------

Notice that object c is the only one which is made up of curved lines and is elliptical nad therefore it can be <u>distinguished</u> from all of the other objects and <u>identified</u>.

Below is written as much of the key as we have so far.

1a - objects with curved lines ---------- 2

1b - objects with straight lines ----------

2a - objects are made up of circles ------- 3

2b - object is elliptical ---------- object c

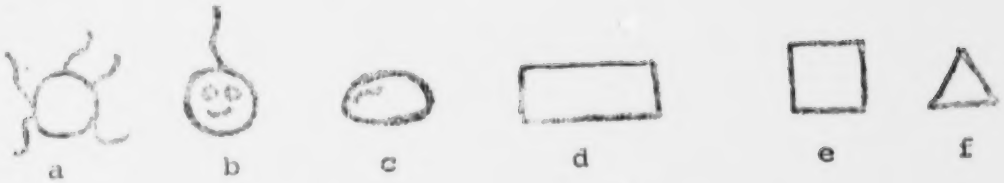
Now we will subdivide group 2a. We will do this in groups 3a and 3b, so we place a 3 after 2a.

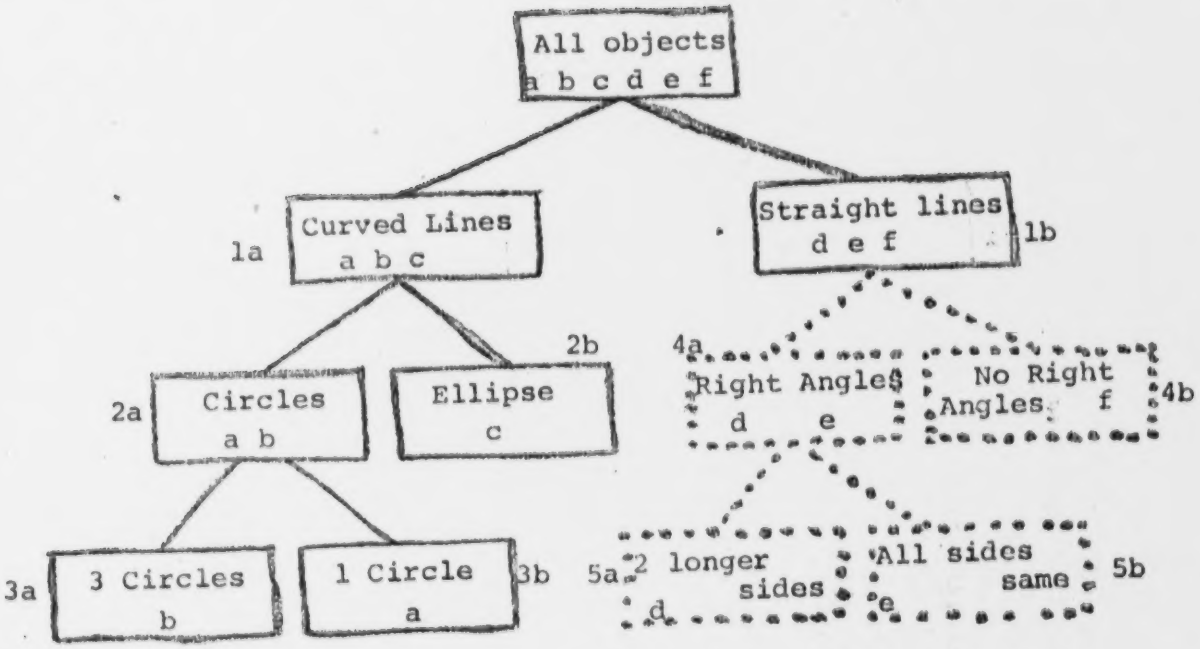
3a- object contains 3 circles ---------- object b

3b - object contains 1 circle ---------- object a

We have now grouped in this way:

Figure 2-9





Objects a, b, and c are taken care of. Now we will finish the key.

Below is a completed key to the six objects pictured.

1a - objects with curved lines ---------- 2

1b - objects with straight lines ---------- 4

2a - objects made up of circles ---------- 3

2b - object is elliptical ---------- object c

3a - object contains 3 circles ---------- object b

3b - object contains 1 circle ---------- object a

4a - object contains right angles ---------- 5

4b - object contains no right angles ---------- object f

5a - object has 2 sides longer than the other 2 ------- object d

5b - object with all four sides the same length ------- object 3

The new sections were shown on the chart with dotted lines. Study the steps by which this key has been made.

Evaluation:

Pick up material from instructor and develop a Key as per instructions.

Another sample key is given below. Can you find the proper name for the leaves pictured? You may have to use your text to find some of the terms.

Figure 2-10

This will serve as part of your self-appraisal. Check the bulletin board for answers to see if you have followed the key properly. Before you start, cover the letters on the leaves. Then see if you get the right answers.

1a - leaves simple ---------- 2

1b - leaves compound ---------- 5

2a - leaves with parallel veins ---------- 3

2b - leaves with net veins ---------- 4

3a - leaves sessile (without peticle) ------- leaf d

3b - leaves with peticles ---------- leaf b

4a - leaves with indented margins ---------- leaf a

4b - leaves with smooth margins ---------- leaf c

5a - leaflets consisting of single blades and sessile ---------- leaf e

5b - leaflets consisting of four blades peticles present ---------- leaf f

CLASSIFICATION PART 2

A Catalog of Living Things

Rationale:

Why do we classify? If you think about it, I'm sure you will find almost everything man works with is organized into some type of classification system. This may be in automobile parts to the school library or in the grocery store to the fi files in a hospital, as well as stars, clouds, soils, words, etc.

The system of Binomial Nomenclative as classification of living organism is called and ordered this way.

Kingdom
Phylum
Order
Family
Genus
Species

With the kingdom having in it largest and most diverse grouping down to Genus species (two names) this group of organisms which are very simillar, live in the same general habitat and interbreed naturally, there is much more to classification or the study of it (taxonomy) but this you will understand as you read in different books and as you study our own natural area around the Santa Cruz Valley later this school year.

Objectives:

8. Describe the Kingdoms of Organism.

9. Describe Phylums of the Kingdoms as listed in the activities.

10. Name and order in the system of taxonomy two organisms from Kingdom to species.

Activity I:

Look through Appendix II, page 782, Green Version.

Activity II:

Do Lab 4.1 in Green Version.

Activity III:

Read from page 104 in Green Version
Read from page 144 to 151, Living Things

Activities:

1. Read chapter six, do questions 7, 8, 13, 14, - page 212
   Do problems 1 and 3.
2. Do lab 6.1 - page 189 Green Version (Long group lav)
3. Observe prepared slides on selected protest which are with the microscopes at the lab tables.
4. Read chapter seven, answer guide question 1, answer problem 3.
5. Lab 7.1 - page 216 (individual lab)
6. Look at filmstrip on:
   a. Protozoa
   b. Algae
   c. World of Work
7. Write a short paper on three careers in the world of work that deals with life, one of which must deal with microorganisms.

Final Evaluation:

Have your note book checked to show that activities have been completed. Then take test from instructor (Review objectives first).

Quest:

Lab 6.2 through 6.4. See instructor for help here.

UNIT I

Information Sources:

1. Organic material is from or was or still is alive. Where as inorganic material never was alive? The question mark is because in some cases neither definitions are any good for it is sometimes very difficult to tell which is which. Generally things like rock, air, salt, and water are considered inorganic. Also all the individual elements on the Periodic Chart also would be inorganic. Okay that's easy enough. But you are made up of inorganic elements and you are organic. So look in texts, dictionaries, and the library for more information.

2. Text Book Green Version High School Biology

chapter six and seven also classification page 782 and 783

3. Filmstrip Classification Protozoa EBE

" Algae EBE

" World of Work SVE

UNIT I

Self Test:

1. From ten objects on lab table separate in groups the organic from the inorganic objects.
2. Why are living things placed in the kingdom Protista?
3. What are microorganisms?
4. How does the organism you cultured reproduce?
5. What is necessary in order for microorganisms to be cultured?
6. List three careers which had to do with living things.
7. What is the world of work?

Unit VII

Spatial Relationship 2

Rationale:

You have learned to infer the three dimensional form of an object from a two dimensional view. From a series of two dimensional view of an object provided by serial sectioning, you should be able to infer the general form and structure. This technique provides an excellent way of describing an object both externally and internally.

It will also provide insight into your ovservations with the microscope because you will be able to relate your ovservations to whole objects.

Objectives:

The student should:

26. Given an object and sectional views of the object, name whether the views are cross or longitudinal and identify the point on the object from which the section was taken.

27. Given a set of ordered serial-cross-sections construct a drawing of a longitudinal view of the object.

28. Demonstrate the serial sectioning of an object, construct drawings of the sections and order the drawings.

28A. Using any resources, pick at least one career in which you are interested.

Information sources:

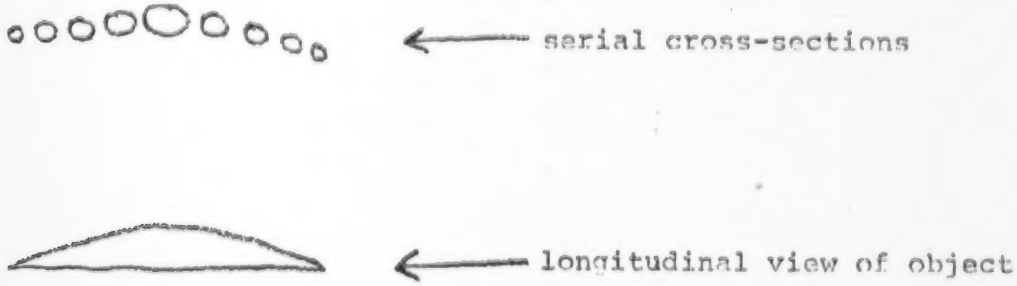
If you are given a cone and a series of sectional views, you should be able to identify and name those which represent cross and those which represent longitudinal sections.

Figure 7-1

In figure 7-1, Drawing A represents a cross section from the cone. By measuring the diameter of the section one can determine that the cone would generate this section only if it were sectioned at Point 1. View B represents a longitudinal section cut from the cone. Since one side is flat the cut must have been started along the flat side of the cone. Such a cut would provide a longitudinal view of the object. Measuring the section should enable you to decide that the section could have been taken at either Point 2 or 3.

When given a set of ordered serial cross-sections, you should be able to construct a drawing of a longitudinal view of the object. The drawing below provides a simple example.

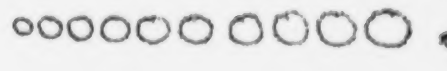
Figure 7-2



Activities:

1. Now see if you can complete 1 and 2:

(1)



(2)

2. To demonstrate the serial sectioning of an object, cut a carrot into a continuous set of cross-sectional slices (3mm thick). Mix all of the slices together. Construct drawings of all the slices including the internal structures of the carrot. Then order the drawings and see if you can reconstruct the carrot in its original form with the internal structures in proper perspective.

3. Observe these dimensional objects in the laboratory. Construct drawings of two dimensional shapes obtained by cutting an imaginary cross-section and longitudinal section of these objects.

4. Show all assignments to instructor.

Unit VIII

Constructing Inferences and Defining Operationally

Rationale

One of the most important abilities that you can develop is the ability to distinguish between an observation and an inference that is made about the observation. Observations are made by using one of the senses. An inference involves the thought process since it is an explanation of an observation.

For example, you observe that the wind is blowing hard, and all at once the electricity goes off. You then, based on past experience, infer that the wind has damaged the power line and this explains the reason the electricity is off. In order to be sure you haven't jumped to a false conclusion, it is necessary to see if your inference is supported by further observation. In this example you could observe the power lines in the neighborhood to see if further observation supported your first inference. If, during your observation of the power line, you observed that a car had damaged a pole supporting the power line, you would make a second inference since further observation didn't support the first one.

In your project you will learn to make careful observations, construct several inferences about each set of observations, and decide what new observations would help support the inferences. Next you must decide, based on these new observations, whether each of the inferences is an acceptable explanation.

The ability to define operationally is of the utmost importance in developing your ability to use the science process in solving problems. Operational definitions can be used to test inferences and hypotheses. They can also be formulated in such a way that they become valuable in constructing inferences and hypotheses.

Objectives:

36. Distinguish between observations and inferences about objects.

37. Construct inferences based on observations of biological objects or phenomenon.

38. Distinguish between an operational and descriptive definition.

39. Construct an operational definition of an object which is being observation and/or manipulated.

39A. List attitudes and work habits you would expect an employee to have in the career area of your choice.

Information sources

You have already made and recorded observations about a variety of materials. Occasionally you probably made a mistake and constructed an inference based on one of your observations. Let's look at a typical mistake. Students often record their observations in regard to odor in the following manner: "It has no odor." The statement as recorded is an inference since you are inferring that no one can detect an odor. To make an observation you would have to say, "I couldn't detect any odor." If you were describing a preserved frog and said, "This object was once alive," you would be making an inference and not an observation. If you saw a student across the street from you, staggering and concluded that he was drunk, you would be necessary to decide what new observations would help support the inference. What further observation would be necessary in this situation.

When you define operationally you state what you do or what observation you perform and what you observe. Example: "Starch is a substance that turns purple (what you observe) when a solution of iodine is applied to it (what you do)." A descriptive definition of starch would be: "Starch is a substance composed of repeating units of glucose sugar linked from the Number 1 carbon of one unit to the Number 4 carbon of the next unit." As you can see, the operational definition is much more satisfactory. It can also be useful as a test for inference you might make relating to starch.

For example, if you make the inference. "That potato contains starch," your operational definition of starch enables you to test your inference.

The operational definition can also be helpful in the formulation of inferences and hypotheses since the test is a required part of a good inference or hypotheses. The example of an inference given in the paragraph above, "That potato contains starch," wouldn't be a particularly good inference unless it could be tested. The operational definition of starch we constructed provided the test by which we could make further observations which enabled us to decide whether our inference is acceptable.

A well-written hypothesis usually will include a test, which comes from an operational definition. Therefore, learning how to define operationally will be quite valuable when you need to construct hypothesis.

Activities and self appraisal

1. Observe a preserved frog. Distinguish whether the statements below are observations or inferences about the organism. Place an "I" in front of the statement if it is an inference and an "O" if the statement is an observation.

___ This object was once alive.

___ The underside of the object is lighter in color than the upper side.

___ The object is bilaterally symmetrical.

___ The object has a heart.

___ The object is preserved in alchohol or formulin.

___ The object is spotted on the backside.

___ The object has a large mouth.

___ The object has teeth.

___ The object has webbing between the toes of the hind feet.

___ The hind legs are used for jumping.

____ The object lays eggs.

(You may check your answers on the following page.)

After you have checked the statements about the frog that are inferences, decide what new observations would help support your inferences. Write them below and discuss them with your partner or the instructor.

2. Select another of the preserved animal specimens or one of your own collection specimens and construct five inferences based on your observations. Then decide what new observations would help support the inferences. Discuss these with your instructor.

3. Distinguish the definitions below that are operational by placing an "O" in front of them, and those that are descriptive by placing a "D" in front of them.

____ Carbon is an element composed of 6 protons, 6 electrons, and 6 neutrons.

____ Oxygen is a gas that causes a glowing splint to burst into flame when the splint is placed in a container of the gas.

____ A nail is a steel cylinder that will hold two objects together when it is hammered into them.

____ A pencil is an object that will mark a piece of paper when pressed against it.

____ A water faucet is a structure from which water flows if you open the valve.

____ A screw is an object with a head at one end, threads, and a tapered point at the other end.

____ Sugar is a substance composed of small, white, irregular crystals that are sweet to the taste.

(You many check your answers on the following page.)

ANSWER 1. I, O, O, I, I, O, O, I, O, I, I.

ANSWER 3. C, O, O, O, O, D, D.

4. Obtain an envelope which contains the objects you are to operationally define. Construct an operational definition for each of the objects by observing and/or manipulating. Write down your definitions and discuss with your partner and your instructor.

5. Look around the room. Construct operational definitions for at least five objects you observe. Write them down. Now construct descriptive definitions for each of the same objects. Compare. Discuss with your instructor.

Unit ~~VI~~ IX

Cells

Rationale:

What are cells? What do they do? These are some of the questions you might ask.

In this unit learn to answer these questions in general terms and later in other objectives you will learn what cells do and how they do it.

You will need to have an understanding of cells in order for you to operate and understand how living things (organisms) "do their thing". For cells in general are the single smallest unit of which all living things are made.

Objectives:

20. Construct and name the parts of a cell

21. Distinguish 5 different kinds of cells

22. Describe the cell parts

    22A Describe careers in Vet medicine. At least 5 of them with the amount of training needed to obtain the jobs.

Activities:

1. Read about cells in Green Version, page 379.

   Read about cells in Living Things, pages 9-40.

2. Use the micro film viewers set 58 on Cell Structure and look at other sets.

3. Construct a cell (generalized), and label the parts.

Cell membrane	Plostic
Mitochondria	Ribsomes
E.R. (endophomic reticulum)	Vocuole
Nucleor membrane	Cyloplost
Chromosome	

4. Write the functions of the cell parts in the place provided in Activity 3.

5. Obtain slides and use the microscope to look at different

kinds of cells, also use the micro film viewers.

Test

Obtain test from teacher after you are sure you know the objectives.

Cell Unit IX: Pa t II

Rationale:

Among cells of different organisms there are definite similarities in chemical make up as well as internal structure. There are also many differences from one organism to another as well as within a multicellular organism.

In division of cell with a nucleus, the process of division is very similar involving a definite sequence of events called mitosis.

The results of this process in unicellular organisms is reproduction since new individuals (usually 2) are developed, in multicellular organisms like yourself, it results in growth, healing or replacing tissues.

Objectives:

23. Demonstrate the ability to make a mount of an onion and use the microscope in finding cell parts.

24. Describe how cell reproductuion occurs in cells with a recognizable nucleus. (mitosis)

25. Distinguish the results of mitosis on unicellular and multicellular organisms.

Activities:

1. Green Version Investigation 11.1

2. Read about Mitosis, page 36 in Living Things.

3. Mitosis in Green Version, page 394.

4. Investigation 11.3 in Green Version.

5. Set 55 in the Microfilm viewer.

Test:

Obtain the test from your instructor.

Unit XI

Plant Reproduction

Plant Reproduction

To understand the sexual reproduction of a plant or an animal you will first have to have a basic understanding of the process of meiosis.

In sexual reproduction two gametes come together to form the new individual. If each gamete, or sex cell, had a full compliment of chromosomes the new individual would have two times the normal number of chromosomes. After only a few motings the chromosome number could be very high. Therefore each gamete has only half the normal (2n) number of chromosomes (or n). This is why meiosis is known also as reduction division.

In this unit you will also study the life cycle of an angio sperm (flowering plant). You will also take a brief look into some of the other types of reproduction that occur within the plant kingdom.

Objectives

1. You will be able to distinguish between sexual and asexual reproduction.
2. You will be able to list from memory the steps in meiosis.
3. You will be able to name the reproductive structures of an angio sperm either orally or written.
4. You will be able to identify the terms
   A. Asexual reproduction
   B. gamete
   C. alternation of generation
   D. sexual reproduction
   E. sprophyte
   F. gametophyte
   G. Zygote
   H. fruit
   I. egg
   J. sperm

Activities

1. Read pages 578-582 and 584-589 in BSCS.
2. Do investigation 16.2
3. Read pages 591-599 in BSCS.
4. Study sheet P-1 to review the reproductive structures of an angio sperm.

The following material has been deleted: Flower-Generalized.
Biology Quiz-Plant Reproduction.

Biology Quiz - Plant Reproduction (20pts)

Match the best definition to each term.

1. _____ a sex cell
2. _____ a matured ovary of a angio sperm.
3. _____ A non-motile femal gamete.
4. _____ The union of 2 gametes
5. _____ Reproductive cycle involving both sexually and a-sexual reproduction.
6. _____ Vegatative reproduction
7. _____ A mostile male gamete.
8. _____ Plant which produces gametes
9. _____ Reproduction involving two types of gametes.
10. _____ Plant which produces spores.

A. Asexual reproduction

B. gamete

C. alternation of generation

D. sexual reproduction

E. sporophyte

F. gametophyte

G. zygote

H. fruit

I. egg

J. sperm

XII

UNIT

HEREDITY

RATIONAL: Heredity is what determines what you are after reproduction, which was studied in the last unit.

Gregor Mendel developed a useful theory of heredity which we still use today with some added theories. The proof of a theory is its useability in science to continue to account for new evidence that comes out of scientific research and the ability to predict results. Mendel's theory has stood up well to this test. A theory as such, is never actually proven in the deepest sense of the word and this is an area not for science anyway.

Mendel's experiments and their results led him to develop his theory which is based on these experiments: that heredity is determined by particles (we call genes), and that these genes are in pairs in the individual. Each pair of genes is for a certain characteristic in an individual but may be for a different expression of that characteristic. The genes for this different expression of the characteristic are called alleles and there may be one more than two alleles for each expression; but normally each individual will have only two genes from each parent. These alleles may be carried in two ways: (a) both being identical, (pure for the characteristic), and (b) each may be different (hybred for the characteristic).

The idea of dominance, where one of the alleles will show its characteristics (as tallness in peas), even though it has the other allele (for shortness in peas). The pea plant will look just as though it had identical alleles (pure for trait), so you will not be able to tell by looking at the individual whether it is pure or hybred for a trait. This of course means that shortness genes in peas is a recessive trait and the individual must be pure for the characteristic if it shows the trait.

There is also the case where one allele does not dominate another and both alleles show themselves in an individual, such as red four-o'clock (pure) and white four-o'clock (pure for trait). If they are crossed, their hybred offspring would be pink. A case where both alleles show themselves together is called incomplete hominence.

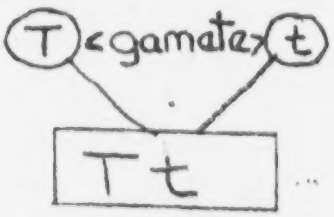
This idea of genes, recessiveness, dominance or incomplete dominance, can be constructed in a model. This model will also give the probibility of the offspring having certain traits.

We will use letters to indicate genes on chromosones such as (T) for tallness, if there is an allel which is recessive for shortness as there is in pea plants, we will use the lower case of the letter to indicate this gene (t) for shortness.

The capital (T) as shown before would indicate the dominent gene for tallness.

The results of a cross of a pure tall pea plant (Homozygous) parent indicated by TT, showing the paired gene on the chromosomes with a pure short pea plant indicated by tt. Remember T indicated the dominent gene for tallness in pea plants, also that t is the recessive trait for shortness.

P_1 = Parent TT x tt



only possible gametes produced by meiosis.

F_1

P_1 = Parent

F_1 = First filial = 1st of Spring

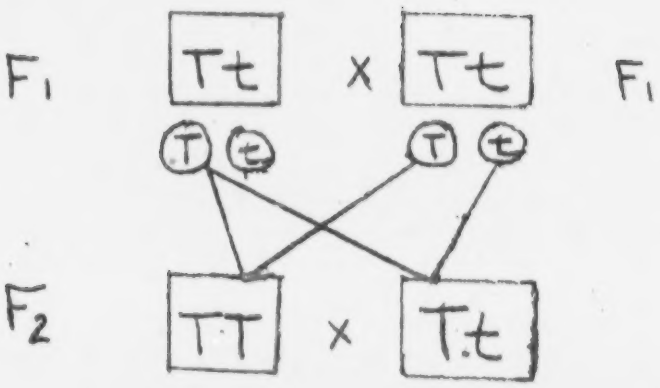
Taking the F_1 generation which are all hybeds (heterozygous), which means having each gene of the pair different (alleles), one for shortness (t) and the other for tallness (T). Since tallness is dominent all the offspring of this cross will look like the tall parent (phenotype), even though its Genotype (the kind of gene it has) one from the tall parent and from the short parent.

Now in crossing the F_1 generation with itself, means the two parents are hybreds for tallness and shortness.

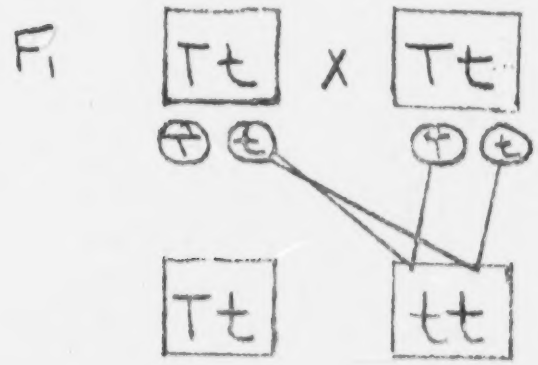
Tt x Tt - individuals are in squares

(T)(t) (T)(t) - gametes are in circles

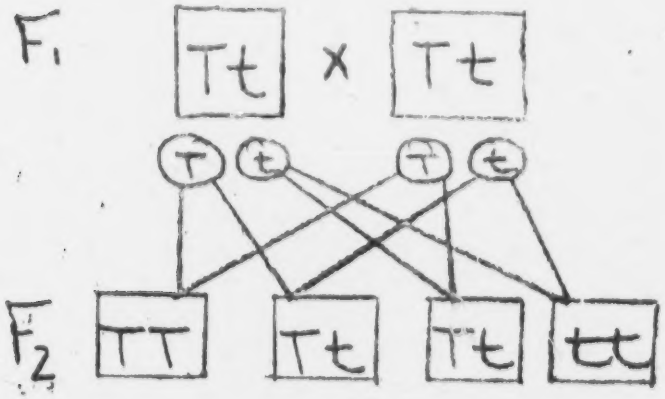
There are two different kinds of gametes formed because each parent has the alleles for tallness and shortness. So the probibility is that 1/2 of the gametes (eggs or sperms) will carry the gene for tallness and the 1/2 of the gametes will carry the gene for shortness. Now each gamete is carrying many other genes besides the ones we are concerned with. These are for all the other traits an individual organism has but we will concern our studies to the known genes, so we only show these:



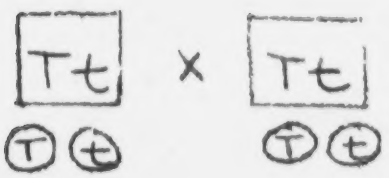
As you see the probibility is that the gamete of one parent joining with or the of the other parent is 50:50 (1/2:1/2), the same is true of the short gametes.

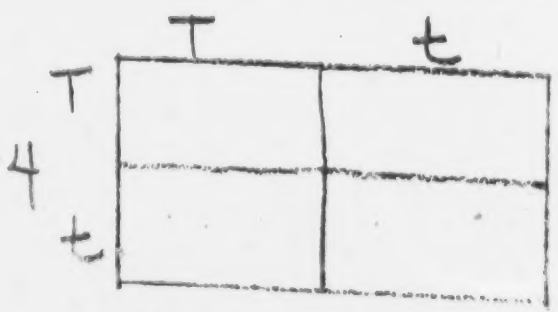


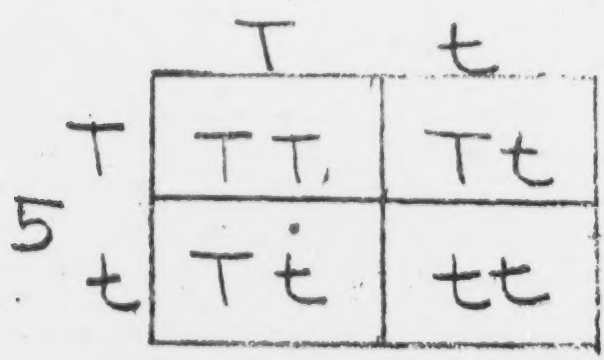
Giving us a total of 4 offspring.



This method of drawing lines from the gametes to all the possible combinations works well with only 1 pair of genes. But if we are to work with more than one pair, another method is much easier. It is one that can be used for these example also; first you take the gametes from one parent and place them on the side of a square; second draw a line between them making the square in two parts; third take the gametes from the other parent and place them on top (equal spacing); fourth, draw a line between them. And fifth, in each box thus formed place the letter representing a chromosome with a gene on it from the top and the side to part two letters in each box.



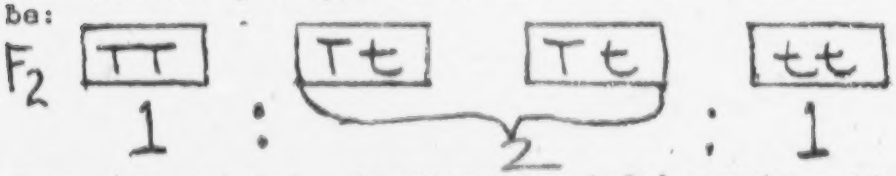




These are the same possibilities as the line method given us. One pure tall [TT], two hybrid [Tt] [Tt], and one pure short [tt]. This phenotype (what the grown individual would look like) ratio is 3 tall and 1 short on an average, because the pure [TT] and the two hybrids [Tt] would all look alike and be tall.

Only pure recessive for shortness [tt] could appear short in the pea plants.

Now the genotype ratio which is the gene the individual has will be:



This ratio of 3:1, phenotype two,1:2:1 genotype are the basic ratios used to derermine offspring and parent for the offspring. This will be discussed in lecture and is also developed in detail in your text book.

Genes are found on chormosomes and are made up of a chemical substance called D.N.A. for short. This molecule is very stable and does not change very often; but if it does, this change in the genes chemistry is called a gene mutation. It may cause a change in the traits of an individual. There are other kinds of mutations which may not be a chemical change, this is a mechanical change in the arrangement of genes on a chromosome or the loss of some genes by lossing parts of a chromosome. There is also the possibility that paired chromosomes will not separate during meiosis (called nondisjunction) thus if fertilization occurs after this, an individual may have 3 chromosomes or more for similar traits causing a change in their expression.

Other men and women have contributed to Mendel's theories, the ones mentioned in your text have all contributed to our present study of genetics. They are: T. H. Morgan-sex chromosomes work with Drosophilia fruit flies: W. S. Suttons-chromosome theory; C. B. Bridges-Nondisjunction.

In many areas of employment the employee needs to have a background of genetics. Materials for these are in the magazine pamphlet rack. The courses involved are in: (1) Fish and Wildlife Management, (2) Forestrey, (3) Timber, (4) Crop and Animal Production, (5) Horticulture Products, (6) Seed Production.

There are other areas also if you find materials in other areas, please bring them in so they may be added to our materials in class.

The areas of employment and skills needed in these fields are varied and many. Some of the jobs need a college degreee, others do not need a high school siploma. But all of them need a good attitude and willingness to do a good job. For these are important to be successful in any employment.

II. OBJECTIVES

53 Describe Mendel's theory of Heredity.

54 Construct a model showing what happens to genes and chromosomes during Meiosis.

55 Construct a model of fertilization showing what happens in the recombination of genes on chromosones.

56 Describe how mutation may occur.

57 Be able to use the principles of probability in predicting offspring types (phenotypes and genotypes) of known parents.

58 Using the principles of probability and knowing the phenotype and genotype of offspring be able to tell the genotype of parents.

(understanding of skills needed to enter into:)

59 Career Cluster: Agriculture-Business and National Resources

Special areas: Timber, Forestry, Fish and Wildlife, Crop and Animal Production, Horticultural Products

HEREDITY
SELF-TEST

1. What is heredity?

2. Define these terms:

   a. dominavne

   b. recessive

   c. pure

   d. hybred

   e. incomplete domimace

   f. Mutation

   g. chromosome

   h. gene

   i. gamete

   j. haploic

   k. diploid

   l. fertilization

3. Show a model and ratio of the cross of the following:

   T= Tall pea vine

   a. t= Short pea vine

P, TT × tt

O O gametes

F,

   b. W= wrinkled skin on pea

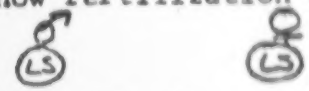
   w= smooth skin on pea

P, Ww × ww

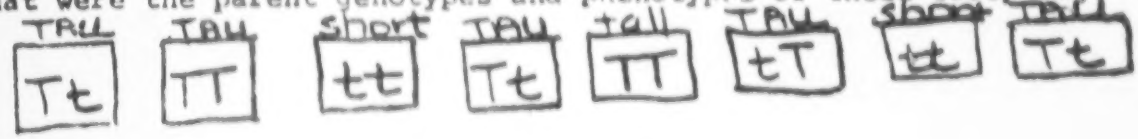
F,

HEREDITY (cont.)
SELF-TEST (cont.)

4. Show fertilization of these gametes:



5. What were the parent genotypes and phenotypes of these offspring:



6. Describe 3 ways in which mutation can occur.

7. Give 2 examples of mutation that you know about.

IV. INFORMATION SOURCES

1. Chapter 17 Green Version
2. Chapter 10 & 11 Living Things
3. Charts in front of room
4. Phonograph record: "Gene the Core of Our Being"
5. Filmstrip set: Introducing Genetics
6. Filmstrip set: D.N.A. the Key to All Life
7. Motion picture: "D.N.A. Molecule of Heredity"
8. Motion picture: "Genetics Improving Plants and Animals"

HEREDITY
Information Sources (cont.)

9. Readings in the library:

a. Chromosome's Disease, Scientific American, Reprint 1961, Nov

b. Genetic is Easy, by Golustein, P.

c. Human Genetics, by Englewood Cliffs

V. ACTIVITIES

Green Version

Read pages	624-628	Do guide question 1.
"	628-636	Do guide questions 2-6
"	636-641	Do guide questions 7-8
"	641-647	Do guide questions 9-12
"	647-652	Do guide questions 13-16
"	653-658	Do guide questions 17-18
"	659-664	Do guide questions 19-23
"	664-669	Do guide questions 24-25

Investigation	17.1	probability pages 629-630
	17.3	Seedling phenotypes 651-652
	17.4	Human inheritance 656-658

VI. FINAL EVALUATION: Ask teacher for it.

VII. QUEST: Do a research paper on Heredity or develop a lab that involves genetics. Ideas on research shelf.